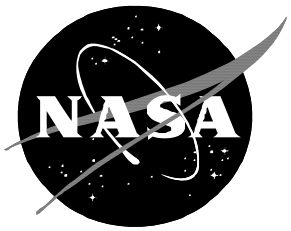

National Aeronautics and Space Administration

Release Date Month DD, YYYY
NNHXXZDAXXXO

Announcement of Opportunity

Standard PI-led Mission AO

Standard AO Template
A Product of the AO Simplification Team

Revision Date: March 19, 2009

Notices of Intent Due Date: **Month DD, YYY**
Proposal Due Date: **Month DD, YYY**

OMB Approval Number 2700-0085

STANDARD PI-LED MISSION AO TEMPLATE

REVISION HISTORY

August 9, 2008 Initial release

December 3, 2008 Revision incorporating lessons learned from development of the Draft New Frontiers AO

- Change in policy, Section 5.6.6 Full Cost Accounting for NASA Facilities and Personnel: For the purpose of calculating the full cost of NASA provided services for proposals submitted in response to this AO, the CM&O burden should be applied only to NASA provided labor including Center civil servants and on-site contractors; this cost must be included in the PI-Managed Mission Cost.
- Addition of new standard language, Appendix B Section J Part 6 Planetary Protection and/or Sample Curation Plan: Added requirements for planetary protection plans and curation plans.
- Clarification of language with minor impact on policy or requirement: Section 4.1.2 NASA Program Management, Section 4.5.1 Independent Verification and Validation, Section 5.1.5.2 Curation of Returned Samples, Section 5.2.5.2 Program Requirements for the Use of Radioactive Material, Section 5.9.2 Launch Services, Appendix B General Requirements, Appendix B Section E Science Implementation.
- Clarification of language without change in policy or requirement: Section 4.1.1 NASA Flight Program and Project Requirements, Section 5.5.2 Core E/PO Program, Section 7.2.1 Overview of Evaluation Criteria, Section 7.4.4 Downselection of Investigations.
- Correction of many dozens of typographical and formatting errors.

March 19, 2009 Revision incorporating clarifications made during development and approval of the Final New Frontiers AO

- Addition of new standard language, Section 4.2.1 Eligibility to Participate in this AO: Stated constraint's on The Aerospace Corporation's ability to respond to this AO and to participate in supporting analysis studies.
- Clarification of language with minor impact on policy or requirement: Section 4.1.2 NASA Program Management, Section 4.1.4 Remediation, Termination, or Cancellation, Section 4.5.1 Independent Verification and Validation, Section 5.5.2 Core E/PO Program, Section 5.6.7 Contributions, Section 7.2.4 Feasibility of the Mission Implementation Including Cost Risk, Appendix B General Requirements, Appendix B Section G Management.
- Clarification of language without change in policy or requirement: Section 4.1 NASA Management Policies, Section 4.1.1 NASA Flight Program and Project Requirements, Section 4.1.2 NASA Program Management, Section 4.3.1 PI-Managed Mission Cost, Section 4.3.2 Total Mission Cost, Section 4.3.3 Enhanced PI-Managed Mission Cost, Section 4.4.1 Data Analysis, Section 4.4.3 Delivery of Data to Archive, Section 5.2.2 Accepted Management Processes and Practices, Section 5.3.1 Principal

Investigator, Section 5.5.1 Small Business Participation, Section 5.5.3 Student Collaborations (optional), Section 5.6.6 Full Cost Accounting for NASA Facilities and Personnel, Section 6.2.1 Structure of the Proposal, Section 7.4.2 Award Administration and Funding, Section 7.4.4 Downselection of Investigations, Appendix C.1 Glossary of Terms, Appendix F Compliance Checklist.

- Correction of very few typographical and formatting errors.

Questions about this Standard PI-Led Mission AO Template may be addressed to:

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ANNOUNCEMENT OF OPPORTUNITY
<<PROGRAM NAME>> PROGRAM
NNHXXZDAXXXO

FOREWORD

The National Aeronautics and Space Administration (NASA) Science Mission Directorate (SMD) is releasing this Announcement of Opportunity (AO) to solicit Principal Investigator (PI)-led space science investigations for the <<PROGRAM>> Program.

The PI Mission Cost cap for a <<PROGRAM>> mission is $<<NUMBER>>M in Fiscal Year (FY) <<YEAR>> dollars, not including the cost of the Expendable Launch Vehicle (ELV) or any contributions. NASA expects to select up to <<NUMBER>> <<PROGRAM>> missions to proceed into Phase B and subsequent mission phases. The selected missions will launch no later than <<DATE>>.

Proposers should be aware of the following major changes in this AO from previous <<PROGRAM>> Program AOs.

- Reserves.
- Contributions.
- Launch services.
- Other special or new rules.
- Mission of Opportunity investigations are no longer solicited through the <<PROGRAM>> AO. Mission of Opportunity will be solicited through the Stand Alone Mission of Opportunity Notice (SALMON) AO.

This AO is based on SMD's Standard PI-Led Mission AO. In addition to the changes listed above, proposers should be aware of the following changes in this AO from the language in the Standard PI-Led Mission AO.

- Change 1 in Section 2.3.4.
- Change 2 in Section 4.5.6.

Proposers should be aware of the following major changes in this AO from the Draft <<PROGRAM>> AO released for community comment on <<DATE>>.

- The cost cap is now $1B; this is specified in Section 5.6.7.
- Section 1.2.3 now requires something new.
- Sections 4.4.3 (*Title),* 8.4.2 (*Title),* Appendix B, Section H *(Title)* have been clarified.
- A new section 3.4.5, *Title,* has been.
- A new requirement for Something has been added (Section 5.6.7).

In addition to the listed major changes, this AO incorporates a large number of additional changes relative to previous <<PROGRAM>> Program AOs including both policy changes and changes to proposal submission requirements. All proposers must read this AO carefully, and all proposals must comply with the requirements, constraints, and guidelines contained within this AO.

ANNOUNCEMENT OF OPPORTUNITY
<<PROGRAM NAME>> PROGRAM
NNHXXZDAXXXO

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APPENDICES

ANNOUNCEMENT OF OPPORTUNITY
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1. Description of Opportunity

1.1 Introduction

The National Aeronautics and Space Administration (NASA) issues this Announcement of Opportunity (AO) for the purpose of soliciting proposals for investigations to be implemented through its <<Program Name>> Program. All investigations proposed in response to this solicitation must support the goals and objectives of the <<Program Name>> Program (Section 2), must be implemented by Principal Investigator (PI) led investigation teams (Section 5.3.1), and must be implemented through the provision of complete spaceflight missions (Section 5.2.1).

Proposed investigations will be evaluated and selected through a two-step competitive process (Section 7). Step 1 is the solicitation, submission, evaluation, and selection of proposals prepared in response to this AO. As the outcome of Step 1, NASA intends to select approximately <<NUMBER>> Step 1 proposals and issue awards (provide funding to NASA Centers and JPL, award contracts to non-NASA institutions, or utilize other funding vehicles as applicable) to the selected proposers to conduct Phase A concept studies and submit Concept Study Reports to NASA. Step 2 is the preparation, submission, evaluation, and continuation decision (downselection) of the Concept Study Reports. As the outcome of Step 2, NASA intends to continue up to <<NUMBER>> investigation(s) into the subsequent phases of mission development for flight and operations.

This AO, particularly Section 5, presents the requirements and constraints that apply to proposals that are to be submitted in response to this AO. Appendix B contains additional requirements on the format and content of the Step 1 proposal. Appendix E.1 lists the Program Library documents that specify requirements for Phase A concept studies, and Appendix E.2 and E.3 list the Program Library documents that specify requirements that will apply to subsequent phases of investigations that are selected for implementation. These documents are intended to provide guidance for investigations selected in Step 1 and Step 2, respectively; they are specifically <u>not</u> intended to impose requirements on Step 1 proposals.

1.2 NASA Safety Priorities

Safety is the freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. NASA's safety priority is to protect: (1) the public, (2) astronauts and pilots, (3) the NASA workforce (including NASA employees working under NASA instruments), and (4) high-value equipment and property.

2. AO Objectives

2.1 NASA Strategic Goals

One of NASA's strategic goals is to <<program specific text>>. Further information on NASA's strategic goals may be found in NASA Policy Directive (NPD) 1001.0, *The 2006 NASA Strategic Plan,* available through the Program Library (Appendix D).

The NASA Science Mission Directorate (SMD) is addressing this strategic goal by <<program specific text>>.

and is addressing the following research objectives: <<program specific text>>

Further information on the goals and objectives of NASA's <<Program Name>> program may be found in *The Science Plan for NASA's Science Mission Directorate (2007-2016)* and in the *<<Program Name>> Roadmap,* available through the Program Library.

2.2 <<Program Name>> Program Goals and Objectives

2.3 <<Program Name>> Program Background

3. Proposal Opportunity Period

This solicitation has a single submission deadline. The following schedule describes the major milestones for this AO:

AO Release Date	<<DATE>>
Preproposal Conference	<<DATE + 3 weeks>>
Notice of Intent to Propose Deadline	<<DATE + 4 weeks>>
Proposal Submittal Deadline at 4:30 p.m. Eastern Time	<<DATE + 3 months>>
Letters of Commitment due (with proposal)	<<DATE + 3 months>>
Selections announced (target)	<<DATE + 8 months>>
Phase A Concept Study Reports due (target)	<<DATE 2>>
Down-selection of investigation(s) for flight (target)	<<DATE 2 + 5 months>>
Launch Deadline	NLT <<DATE 3>>

All proposals, U.S. and non-U.S., must be received before the proposal submittal deadline. Those received after the closing date will be treated in accordance with Appendix A, Section VII.

Requirement 1. Proposals submitted in response to this solicitation shall be delivered no later than the Proposal Submittal Deadline. Proposals shall be delivered to the Address for Submittal of Proposals given in Section 6.2.3.

Requirement 2. Proposal submission shall be accompanied by electronic submission of proposal summary data no later than the Proposal Submittal Deadline following the instructions for submission of proposal summary data provided in Section 6.2.4.

4. **Policies Applicable to this AO**

4.1 NASA Management Policies

The following policies will impose requirements on selected missions, for which planning may need to be considered and described as part of the proposal process. These requirements are not levied on Step 1 proposals.

4.1.1 NASA Flight Program and Project Requirements

Proposals selected in response to this AO will be implemented in accordance with NASA mission management processes. NASA mission management processes, as defined by NASA Procedural Requirements (NPR) 7120.5D, *NASA Space Flight Program and Project Management Requirements*, are Formulation, Approval, Implementation, and Evaluation. The NASA mission management processes are subdivided as follows:

Formulation is divided into:

- Phase A – Concept Study and Technology Development; and
- Phase B – Preliminary Design and Technology Completion.

Approval is the Confirmation process for transitioning into Implementation.

Implementation is divided into:

- Phase C – Final Design and Fabrication;
- Phase D – System Assembly, Integration and Test, and Launch (extending through in-orbit checkout);
- Phase E – Operations and Sustainment; and
- Phase F – Closeout.

Evaluation is the ongoing independent review and assessment of the project's status during both Formulation and Implementation as described in NPR 7120.5D, which may be found in the Program Library.

A Key Decision Point (KDP) occurs before the project is approved to begin the next phase of development; KDPs are defined in NPR 7120.5D. For missions selected as a result of this AO, KDP-A is the selection of a Step-1 proposal for a Phase A concept study, KDP-B is the downselection of a mission to enter Phase B (or an extended Phase A) following evaluation of Concept Study Reports, KDP-C is the culmination of the Confirmation process, KDP-D is a soft transition that occurs after an appropriate review, KDP-E is the handoff from development to operations following in-orbit checkout, and KDP-F is the decision to terminate the mission.

4.1.2 NASA Program Management

Owing to the significant expenditure of government funds on these spaceflight investigations, as well as to their expected complexity, NASA intends to maintain an essential degree of insight into mission development; NASA will exercise essential oversight to ensure that the implementation is responsive to NASA requirements and

constraints. NASA requirements and constraints are spelled out in NPR 7120.5D, the *<<Program Name>> Safety, Reliability, and Quality Assurance Requirements* document, and other NASA requirements documents available in the NASA Online Directives Information System (NODIS, http://nodis.hq.nasa.gov/) and in the Program Library. To that end, the Associate Administrator for SMD has established a <<Program Name>> Program Office at the NASA <<Center Name>> Center to be responsible for project oversight. The <<Program Name>> Program Manager at <<Center Name>> Center reports to the <<Program Name>> Program Director at NASA Headquarters. Additional details about the program office staffing, structure, and goals can be found in the *<<Program Name>> Program Plan*, available through the Program Library.

NPR 7120.5D defines project management responsibilities, and it presumes that project management is assigned to a NASA Center or JPL. If an organization other than a NASA Center or JPL is proposed and selected to provide project management for an investigation, then the NASA Center's project management responsibilities under NPR 7120.5D will be assigned to the implementing project management organization. That organization must be prepared to carry out these responsibilities. In such cases, the <<Program Name>> Program Office at the NASA <<Center Name>> Center will retain the Independent Technical Authority (ITA) that would otherwise be invested in an implementing Center or JPL.

The *<<Program Name>> Safety, Reliability, and Quality Assurance Requirements* document, available through the Program Library, will apply to investigations that are selected for Phase A concept studies. Selected investigations that reside at institutions that have NASA-approved safety and mission assurance programs may utilize their own institutional practices in lieu of the guidelines and requirements in this document. Although this document may impose requirements on selected investigations, it does not impose requirements, either implicitly or explicitly, on Step-1 proposals.

4.1.3 Mission Category and Payload Risk Classification

NPR 7120.5D, *NASA Space Flight Program and Project Management Requirements*, establishes guidelines for categorizing NASA missions based on the estimated total mission cost and mission priority level. The mission categorization guidelines are given in Section 2.1.4 and Table 2-1 of NPR 7120.5D.

NPR 8705.4, *Risk Classification for NASA Payloads,* establishes baseline criteria that enable a definition of the risk classification level for NASA payloads. It defines four payload risk levels or classes, A thru D, and provides guidance for programmatic options during development based on this class. The requirements for each class are specified in Appendix B of NPR 8705.4.

<<Program Name>> missions selected from this AO have been determined to be Category <<Mission Category>> missions (per NPR 7120.5D) with Class <<Mission Class>> payloads (per NPR 8705.4).

4.1.4 Remediation, Termination, or Cancellation

Any alteration of a mission that renders it unable to accomplish one or more of its baseline science objectives will be regarded as a descope of the investigation. NASA will review any such descoped set of achievable science objectives to ensure that the investigation remains at or above the Threshold Science Mission (see Section 5.1.3 of this AO). A descope made necessary by the PI's inability to remain within budget or schedule, or failure at any time during development and implementation to maintain a level of science return at or above the Threshold Science Mission, can result in mission cancellation accompanied by appropriate contract action, which may involve termination.

During Phase A, each selected PI will conduct a concept study. The Phase A Concept Study Report must include a commitment by the PI for the PI-Managed Mission Cost, schedule, and scientific performance of the investigation. If, at any time, the cost, schedule, or scientific performance commitments made in the Phase A Concept Study Report appear to be in peril, the investigation will be subject to termination or cancellation.

During Phase B, each selected PI will work with NASA to establish a set of performance metrics for project evaluation with NASA. These will include cost, schedule, and others, as appropriate.

Once an investigation has been confirmed for implementation, failure of the PI to maintain reasonable progress within committed schedule and cost, and/or failure to operate within other applicable constraints, may be cause for NASA to convene a termination review. The Associate Administrator (AA) for the Science Mission Directorate may also call for a termination review any time an excursion above the agreed upon mission cost in Phase C through Phase E occurs, or is projected to occur, by the Mission PI, the implementing organization, or NASA. The objective of such a review is to determine whether remedial actions, including changes in management structure and/or key management team members, would better enable the project to operate within established cost, schedule, and/or technical constraints. If a termination review determines that no remedy is likely to improve matters, NASA may consider mission cancellation and/or contract termination.

4.2 Participation Policies

4.2.1 Eligibility to Participate in this AO

Prospective investigators from any category of organizations or institutions, U.S or non-U.S., are welcome to respond to this solicitation. Specific categories of organizations and institutions that are welcome to respond include, but are not limited to, educational, industrial, and not-for-profit organizations, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), NASA Centers, the Jet Propulsion Laboratory (JPL), and other Government agencies.

The NASA contract with Science Applications International Corporation (SAIC) for evaluation support under this Announcement of Opportunity creates an unmitigatable

organizational conflict of interest for SAIC in the event that any business unit of SAIC has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, SAIC is precluded from participating in any capacity in support of a respondent under this AO.

[AO OPTION 1] The NASA contract with The Aerospace Corporation (Aerospace) for evaluation support under this Announcement of Opportunity creates an unmitigatable organizational conflict of interest for Aerospace in the event that any business unit of Aerospace has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, Aerospace is precluded from participating in any capacity in support of a respondent under this AO. [END AO OPTION 1]

[AO OPTION 2] The NASA contract with The Aerospace Corporation (Aerospace) for evaluation support under this Announcement of Opportunity creates an organizational conflict of interest for Aerospace in the event that any business unit of Aerospace has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, Aerospace is precluded from responding to this AO, from participating as a member of any proposal performance team, and from being proposed as the recipient of any work awarded under this AO. Aerospace may support proposal teams as described below.

The Aerospace Corporation is a FFRDC, and it has unique capabilities and skills that are made available to the U.S. Government and other organizations under the terms of its sponsoring agreement with the U.S. Air Force. It is in NASA's best interest that, where appropriate and where it does not create organizational conflicts of interest, respondents to this AO be permitted to take advantage of these same capabilities and skills to improve their proposals. Respondents to this AO may contract with the Aerospace Corporation for supporting analysis services including cost analysis, engineering analysis, resource analysis only under the following conditions:

(i) Aerospace is precluded from responding to this AO, from participating as a member of any proposal performance team, and from being proposed as the recipient of any work awarded under this AO. Aerospace is precluded from providing or developing hardware, including any elements or components, that will be proposed for any work awarded under this AO.

(ii) Aerospace has established firewalls within the Aerospace organization to prevent conflicts of interest between Aerospace organizational units and employees supporting NASA's evaluation of proposals and Aerospace organizational units and employees supporting proposal efforts. Any Aerospace supporting analysis services, including supporting cost analysis and supporting engineering analysis, provided to a proposal team must comply with the firewall that has been established by Aerospace and is described in the Aerospace Organizational Conflict of Interest Avoidance Plan.

(iii) The proposer shall fully describe in a memorandum submitted to NASA at the same time as the proposal all of the supporting analysis services provided by Aerospace to the proposing team. The memorandum shall not be bound into the

proposal itself but must be a separate document. This memorandum must describe all of the work that Aerospace provided, must identify any work products of Aerospace that are included in the proposal or its appendices, and must list all Aerospace employees who participated in the Aerospace work. [END AO OPTION 2]

4.2.2 Constraints on Investigations that are Candidates for Selection

Only those investigations that propose to meet cost, schedule, and launch vehicle requirements that do not exceed the constraints identified in this AO and that demonstrate sufficient margins, reserves, and resiliency to ensure mission success within committed cost and schedule, will be considered for selection.

4.2.3 Responsibility of Principal Investigator for Implementation

The primary responsibility for implementing and executing selected investigations rests with the PI, who will have significant latitude to accomplish the proposed objectives within committed schedule and financial constraints. This responsibility, however, will be exercised with essential NASA oversight to ensure that the implementation is responsive to the requirements and constraints of the <<Program Name>> Program.

4.2.4 NASA Concurrence for Replacement(s) of Key Management Team Members

Any replacement of key management team members (including, but not limited to, the PI and the Project Manager (PM)) requires concurrence by NASA.

4.3 Cost Policies

4.3.1 PI-Managed Mission Cost

PI-Managed Mission Cost is defined as the funding that the <<Program Name>> Program will be expected to provide to the PI's implementation team for the development and execution of the proposed project, Phases A through F. It includes any reserves applied to the development and operation of the mission as well. It also includes any costs that are required to be accounted against the PI-Managed Mission Cost, even though the PI is not responsible for those costs (*e.g.*, NASA-provided telecom and network services described in Section 5.2.6). The PI-Managed Mission Cost is capped (see Section 5.6.1).

Examples of costs to be included in the PI-Managed Mission Cost, unless contributed, are: development activities (*e.g.*, instrument development, spacecraft development, management, software, testing), launch services outside of the standard services provided by NASA; Education/Public Outreach, including Student Collaborations in excess of the student collaboration incentive (see Section 5.5.3); subcontracting costs, including fees; science Co-Is and all other personnel required to conduct the investigation, analyze data and publish results, and deliver data in an acceptable format to an approved archive; insurance; NASA-provided telecommunications, tracking, and/or navigation support; any program/project-specific costs (*e.g.*, curation of returned samples); and all labor, including contractor and Civil Servant (NASA and non-NASA).

4.3.2 Total Mission Cost

Total Mission Cost is defined as the PI-Managed Mission Cost (see Section 4.3.1), plus any Student Collaboration costs up to the student collaboration incentive (see Section 5.5.3), plus any additional costs that are contributed or provided in any way other than through the <<Program Name>> Program (see Section 5.6.7). The Total Mission Cost will define the total value of the baseline investigation, less the cost of standard launch vehicle and launch services.

4.3.3 Enhanced PI-Managed Mission Cost

Enhanced PI-Managed Mission Cost is defined as the funding that the <<Program Name>> Program will be expected to provide to the PI's implementation team for the development and execution of the proposed project including optional components such as any Student Collaboration or Science Enhancement option (see Section 5.1.6). The Enhanced PI-Managed Mission Cost is the PI-Managed Mission Cost (see Section 4.3.1), plus any Student Collaboration costs up to the student collaboration incentive (see Section 5.5.3), plus any Science Enhancement Options (see Section 5.1.6).

4.4 Data Policies

4.4.1 Data Analysis

The PI will be responsible for analysis of the mission data (including returned samples) necessary to complete the proposed science objectives and for timely publication of initial scientific results in refereed scientific journals, as part of their mission operations (Phase E) or post-mission (Phase F) activities.

4.4.2 Data Rights

By NASA policy, all science data returned from NASA missions are immediately in the public domain. A short period of exclusive access may be proposed for data calibration and validation, but a compelling justification for it must be demonstrated. Any period of exclusive access should be the minimum that is consistent with optimizing science return from the mission. Barring exceptional circumstances, it may not exceed six months.

4.4.3 Delivery of Data to Archive

Mission data will be made fully available to the public through a NASA-approved data archive (*e.g.*, the Planetary Data System, Atmospheric Data Center, High Energy Astrophysics Science Archive Research Center, etc.), in usable form, in the minimum time necessary, but barring exceptional circumstances within six months following its collection. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data prior to delivery to the archive.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in flight), documentation, and related software and/or other tools necessary to interpret the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large.

NASA data archives have budgets to support core activities including the basic ingestion and review of new data. Proposed mission data archiving plans and budgets must be consistent with the policies and practices of the appropriate NASA data archive.

4.5 Project Management Policies

4.5.1 Independent Verification and Validation

The NASA Chief Safety and Mission Assurance Officer has the authority to select software projects to which Independent Verification and Validation (IV&V) is to be applied, as outlined in NPD 2820.1, *NASA Software Policy*. The selection of projects is based on prioritized recommendations from the Agency's IV&V Board of Directors. Proposal teams are encouraged to contact the Chief for Plans and Programs at the NASA IV&V Facility to gain a preliminary understanding of the potential level of safety and mission critical software that their project will contain and the associated project system software risks. If the project is selected to receive IV&V services, the costs for these services will be covered within the allocation to the NASA IV&V Program and need not be included in the proposed PI-managed Mission Cost. Selected investigations will have to spend project funds only to provide required data and information to the IV&V facility. The Chief for Plans and Programs at the NASA IV&V Facility is Christina Moats (Telephone: 304-367-8340; E-mail: christina.d.moats@nasa.gov).

4.5.2 Earned Value Management Plan

NPR 7120.5D, Section 4.5.2.c(2), requires projects to implement earned value management (EVM) in Phase C through Phase E. The requirements for EVM implementation are given in NPR 7120.5D, Appendix F, Section 3.1). One requirement is that, for contracts and subcontracts valued at $50M or more, the contractor EVM system must be formally validated by the cognizant Federal management agency.

4.5.3 Cost Analysis Data Requirement (CADRe)

NASA has established a Cost Analysis Data Requirement (CADRe) in NPR 7120.5D, Section 4.5.2.c(3), that will apply to investigations selected through this AO. Support contractors funded directly by NASA Headquarters will perform the actual development of the CADRe; the costs for these services need not be included in the proposed PI-managed Mission Cost. Selected investigations will have to spend project funds only to collect existing documentation and transmit it to the CADRe support contractor at selected major milestones and then to review the completed CADRe for completeness and accuracy.

5. Requirements and Constraints

This section provides general requirements on Step 1 proposals. Supplemental requirements on standard proposal content and format are provided in Appendix B.

5.1 Science Requirements

5.1.1 Scope of Proposed Investigation

A goal is understood to have a broad scope (*e.g.,* discover whether life exists elsewhere in the Universe), while an objective is understood as a more narrowly focused part of a strategy to achieve a goal (*e.g.*, identify specific chemical, mineralogical, or morphological features on Mars that provide evidence of past or present life there).

Requirement 3. Proposals shall describe a science investigation with goals and objectives that address the program science objectives described in Section 2.

5.1.2 Traceability of Proposed Investigation

The <<Program Name>> Program is intended to perform focused science investigations that conclude with papers published in peer-reviewed archival journals, as well as deposition of appropriately reduced and calibrated data in designated data archives (see Section 4.4.3)

Requirement 4. Proposals shall clearly state the relationship between the science objectives, the data to be returned, and the instrument complement to be used in obtaining the required data (see Appendix B, Section D, for additional detail).

Requirement 5. Proposals shall include a plan to calibrate, analyze, publish, and archive the data returned, and shall demonstrate, analytically or otherwise, that sufficient resources have been allocated to carry out that plan within the proposed mission cost. The data plan shall discuss and justify any period of exclusive access to data (see Appendix B, Section E, for additional detail).

5.1.3 Mission Science Objectives and Requirements

The ability to determine whether a proposed mission can successfully carry out the proposed science investigation depends on a crisp, well-formulated articulation of the proposed science objectives, the information and steps needed to bring closure to the objectives, and the measurements that must be obtained while conducting the mission. The proposed mission is evaluated against the standard of successfully delivering the required measurements.

Requirement 6. Proposals shall state the specific science objectives and their required measurements at a level of detail sufficient to allow an assessment of the capability of the proposed mission to make those specific measurements and whether the resulting data will permit achievement of these objectives (see Appendix B, Section F, for additional detail).

Requirement 7. Proposals shall describe the proposed instrumentation, including a discussion of each instrument and the rationale for its selection.

5.1.4 Baseline and Threshold Science Missions

The Baseline Science Mission and the Threshold Science Mission are defined in NPR 7120.5D as follows:

> The "Baseline Science Mission" is the mission that, if fully implemented, would achieve the full science objectives proposed for the investigation.
>
> The "Threshold Science Mission" is the mission that would accomplish the minimum subset of Baseline Science Mission science objectives sufficient to justify the proposed cost of the mission. The threshold science requirements set the science floor for the proposed mission.

The differences between the Baseline Science Mission and the Threshold Science Mission provide resiliency to potential cost and schedule growth in the proposed development and implementation plan. A descope is any alteration of a mission that renders it unable to accomplish one or more of the Baseline Science Mission science objectives, but allows accomplishment of all Threshold Science Mission science objectives.

NASA recognizes that, in some circumstances, the Threshold Science Mission may be identical to the Baseline Science Mission.

Requirement 8. Proposals shall specify only one Baseline Science Mission and only one Threshold Science Mission.

Requirement 9. Proposals shall not include any descopes or other risk mitigation actions that result in the mission being unable to achieve the Threshold Science Mission objectives.

5.1.5 Planetary Protection and Sample Return Policies

AO OPTION: One or more of these sections are to be included in the AO only for programs to which they are applicable.

5.1.5.1 Planetary Protection

Investigations are subject to the established NASA policies and procedures that address forward contamination (transmittal from Earth to a targeted solar system body) and backward contamination (transmittal to Earth from the targeted body) with respect to other solar system bodies (see NPD 8020.7F, *Biological Contamination Control for Outbound and Inbound Planetary Spacecraft;* NPR 8020.12C, *Planetary Protection Provisions for Robotic Extraterrestrial Missions*; and NASA-HDBK-6022, *NASA Handbook for the Microbiological Examination of Space Hardware (DRAFT),* in the Program Library). Note that forward contamination is of particular concern for Mars and for possible liquid water bodies within icy satellites.

Return of samples from certain target bodies may be subjected to rigorous containment and biohazard testing protocols in accordance with NASA planetary protection policy

(see NPR 8020.12C, *Planetary Protection Provisions for Robotic Extraterrestrial Missions* and NASA/CP-2002-211842, *A Draft Test Protocol for Detecting Possible Biohazards in Martian Samples Returned to Earth*, in the Program Library). For additional information, proposers may contact the NASA Planetary Protection Officer (Telephone: 202-358-3912; E-mail: planetaryprotection@nasa.gov).

Requirement 10. Proposals that include an encounter with another solar system body, via flyby, orbiter, lander, or end of mission impact shall address plans for contamination control, as required by NPD 8020.7F and NPR 8020.12C; such investigations shall bear all additional costs generated by any special planetary protection requirements.

Requirement 11. Proposals that include the return of extraterrestrial samples shall address plans to comply with planetary protection requirements as required by NPD 8020.7F and NPR 8020.12C; such investigations shall bear all additional costs generated by any special planetary protection requirements.

See Appendix B, Section J.6.A, for additional detail.

5.1.5.2 Curation of Returned Samples

All samples of extraterrestrial planetary materials returned by NASA missions are NASA property (see NPD 7100.10E, *Curation of Extraterrestrial Materials*, in the Program Library). They shall be delivered to, and processed by, the NASA Astromaterials Curatorial Facility located at NASA's Johnson Space Center (JSC); contact Dr. Carlton Allen, Astromaterials Curator (Telephone: 281-483-5126; E-mail: JSC-Astromaterials-Curator@ndc.nasa.gov@nasa.gov; http://curator.jsc.nasa.gov/). The Curator will assist proposers in designing a curation plan that meets their mission's requirements for sample preservation and use (see the *NASA Policy on Curation of Extraterrestrial Materials* document in the Program Library.) The actual costs for all aspects of curation, from planning through distribution and storage, including all required laboratory construction or modification, shall be borne by the mission from inception to two years following sample return.

Requirement 12. Proposals that include the return of extraterrestrial samples shall provide a Sample Curation Plan. See Appendix B, Section J.6.B, for details.

Requirement 13. Proposals that include the return of extraterrestrial samples shall allocate funding for use of the JSC Curatorial Facility including all aspects of curation.

5.1.5.3 Allocation of Samples to Non-U.S. Partners

As a proportionate return for investment by non-U.S. partners in a mission that returns extraterrestrial materials, a fraction of the total returned sample may be forwarded to the national curatorial facility of the contributing country within six months after delivery to the NASA Astromaterials Curatorial Facility. The amount of samples so transferred must be no more than 25% of the total. Any material allocated to non-U.S. partners during the preliminary examination period must be included in this 25% limitation.

Requirement 14. Proposals that include the return of extraterrestrial samples shall specify the terms and conditions of selection of a sample fraction no greater than 25% for transmission to the contributing country, if appropriate.

In the event that the investigation is selected, the final arrangements for the transfer of a fraction of the sample to the contributing country must be established through an international agreement between NASA (with the approval of the Astromaterials Curator) and the contributing non-U.S. partner. NASA will negotiate the terms and conditions of the agreement.

5.1.6 Science Enhancement Options

Activities such as extended missions, guest investigator programs, general observer programs, participating scientist programs, interdisciplinary scientist programs, and/or archival data analysis programs, where appropriate, have the potential to broaden the scientific impact of investigations. Such optional activities may be proposed as Science Enhancement Options (SEOs).

NASA considers any proposed SEO activities as optional. Inclusion of such optional activities in a proposal does not imply a commitment from NASA to fund them, even if the baseline investigation is selected. NASA reserves the right to accept or decline proposed SEO activities at any time during the mission; in particular, the decision may not be made at the time the baseline investigation is selected for flight. The process for deciding on SEO activities may involve further reviews (*e.g.*, a "Senior Review" for extended missions). NASA reserves the right to solicit and select all participants (*e.g.*, guest investigators, archival data analysts, and participating scientists) in such programs.

Costs for proposed SEO activities must be defined but will not count against the PI-Managed Mission Cost cap. Funding requested for SEO activities prior to Phase E should be minimized. As these proposed activities are optional and are not included within the cost capped baseline investigation, the science enabled by SEO activities is not considered as part of the scientific merit of the proposed investigation.

Requirement 15. If SEO activities are proposed, the proposal shall define and describe the proposed activities and their costs.

Requirement 16. If SEO activities are proposed, they shall be clearly separable from the Baseline Science Mission and Threshold Science Mission investigations.

Requirement 17. If an extended mission SEO is proposed, it shall conform to the guidelines provided in the *SMD Mission Extension Paradigm* document found in the Program Library.

See Appendix B, Section E, for additional detail.

5.2 Technical Requirements

5.2.1 Complete Spaceflight Missions

The term “complete” encompasses all appropriate mission phases (see Section 4.1) from project initiation (Phase A) through mission operations (Phase E), which must include analysis and publication of data in the peer reviewed scientific literature, delivery of the data to an appropriate NASA data archive, and, if applicable, extended mission operations or other science enhancements (see Section 5.1.6), and closeout (Phase F). The term “spaceflight missions” is defined as Earth orbital and deep-space missions; it specifically excludes suborbital missions (*e.g.*, via sounding rockets, balloons, and aircraft).

Requirement 18. Proposals submitted in response to this AO shall be for complete science investigations requiring a spaceflight mission.

Requirement 19. Proposals shall describe the proposed mission architecture and the rationale for each mission element.

Requirement 20. Proposals shall describe the proposed mission design and mission operations concept.

Requirement 21. Proposals shall describe the proposed flight system concept including the spacecraft bus and its major subsystems.

Requirement 22. Proposals shall describe the development approach for implementing the proposed mission within schedule and cost constraints, including a project schedule.

See Appendix B, Section F, for additional detail.

5.2.2 Accepted Management Processes and Practices

The document NPR 7120.5D, *NASA Space Flight Program and Project Management Processes and Requirements*, delineates activities, milestones, and products typically associated with Formulation and Implementation of projects; it should be used as a reference in defining an Investigation Team’s management approach. The implementing organizations are free to propose their own processes, procedures, and methods for managing their missions; however, they must be consistent with the principles of NPR 7120.5D. Any deviations from NPR 7120.5D will require a waiver during formulation.

Requirement 23. Proposals shall describe the investigation's proposed management approach, including the management organization and decision-making process, the teaming arrangement, the responsibilities of the PI and other team members, and the risk management and risk mitigation plans (see Appendix B, Section G, for additional detail).

5.2.3 New Technologies/Advanced Developments

This AO solicits flight missions, not technology development projects. Proposed investigations are generally expected to have mature technologies, specifically all technologies at a Technology Readiness Level (TRL) of 6 or higher (TRLs are defined in NPR 7120.8, *NASA Research and Technology Program and Project Management Requirements,* Appendix J). Proposals with a limited number of less mature technologies are permitted as long as they contain a plan for maturing all technologies to TRL 6 no later than KDP-C (Confirmation) and adequate backup plans in the event that the technologies cannot be matured as planned.

Requirement 24. Proposals that use technologies currently at less than TRL 6 shall include a plan for technology maturation and a backup plan (see Appendix B, Section F, for additional detail).

5.2.4 Environmental Review Documentation

Following Phase A, selected projects will be required to conduct environmental review consistent with the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 *et seq*.), NASA policy and procedures (14 CFR Part 1216.3 *Procedures for Implementing the National Environmental Policy Act* and NPR 8580.1 *Implementing the National Environmental Policy Act and Executive Order 12114*), and the Council on Environmental Quality (CEQ) *Regulations for Implementing the Procedural Provisions of NEPA* (40 CFR Parts 1500-1508).

Depending on the potential environmental impacts of a selected mission, either (1) use of the "Final Environmental Assessment of NASA Routine Payloads on Expendable Launch Vehicles from Cape Canaveral Air Force Station Florida and Vandenberg Air Force Base California," dated June 2002 and Finding of No Significant Impact (FONSI) dated June 18, 2002, (2) preparation of a mission unique Environmental Assessment, or (3) preparation of a mission unique Environmental Impact Statement will be necessary to satisfy NEPA requirements. Additionally, if the mission has the potential to have environmental effects abroad (*e.g.,* launches from a non-U.S. territory), then the mission will require environmental review documentation consistent with NASA policy and procedures for complying with Executive Order 12114 (14 CFR Part 1216.321) and NPR 8580.1

Questions concerning NEPA may be addressed to the NASA NEPA Coordinator (Telephone: 202-358-1953; E-mail: nepa@hq.nasa.gov).

Requirement 25. Proposals shall include a description of cost and schedules milestones consistent with meeting environmental review requirements.

5.2.5 Use of Radioactive Material

5.2.5.1 General Requirements for the Use of Radioactive Material

The proposed use of radioactive materials of any quantity and any isotope, including radioisotope power sources, radioisotope heater units, or radioactive calibration sources

for science instruments, will require review for environmental impact and nuclear launch safety approval (NLSA). The NLSA requirements are specified in NPR 8715.3, *NASA General Safety Program Requirements*, Chapter 6: "Nuclear Safety for Launching of Radioactive Materials." The effort required for NLSA varies between an E-mail to the Office of Safety and Mission Assurance for radioactive sources less than an A2 (see NPR 8715.3, Chapter 6, for the definition of an A2) to a full interagency review and approval from the Executive Office of the President for radioisotope power sources. Larger radioactive sources may require preparation of either an Environmental Assessment or an Environmental Impact Statement (EIS) to satisfy the NEPA requirements and completion of a detailed and rigorous nuclear safety launch approval process. The Environmental Assessment, if prepared, will form the basis for NASA's decision to either issue a FONSI or prepare an EIS.

Questions concerning the NLSA Process may be posed to <<Program Name>> Program Manager at <<Center Name>> Center.

Requirement 26. If use of radioactive materials is proposed, the proposal shall include a listing of the estimated radioactive materials to be used (isotope, form, quantity). The proposal shall provide a rationale for the use of radioactive materials and possible alternatives. The proposal shall demonstrate a development plan, including allocation of cost and schedule resources, which is consistent with supporting the NEPA process and the NLSA process.

5.2.5.2 Program Requirements for the Use of Radioactive Material

AO OPTION: Programs may have additional policies and requirements concerning the use of radioactive materials, how they will be provided, and how they will be costed within the PI-Managed Mission Cost.

AO OPTION: The use of radioactive materials is permitted.

AO OPTION: The use of radioisotope thermoelectric generators (RTGs) and other radioisotope power sources is prohibited.

AO OPTION: The use of radioactive materials not permitted except in small quantities such as calibration sources and radioisotope heater units (RHUs).

AO OPTION: The flight of substantial quantities of radioactive material can greatly increase the cost and schedule risk of a mission. Consequently, radioisotope-based sources of electrical power that require a substantial quantity of nuclear material, such as Multi-Mission Radioisotope Thermoelectric Generators (MMRTGs), Advanced Stirling Radioisotope Generators (ASRGs), or other radioisotope power sources, are not permitted for missions proposed in response to this AO. However, radioisotope heater units (RHUs) and/or radioactive calibration sources for science instruments may be utilized. The NASA policies and procedures in Section 5.2.5.1, as well as Requirement 26, apply to these radioactive sources.

AO OPTION: If RHUs are to be used in a mission proposed for this AO, NASA and the Department of Energy (DOE) will provide these, as well as the services associated with their provisioning on space missions, as Government-Furnished Equipment (GFE) and Government Furnished Services (GFS).

Requirement 27. The costs of RHUs and their associated services shall be included within the PI-Managed Mission Cost (for pricing information, see the *Radioisotope Heater Unit Information Summary* in the Program Library)..

Launch processing of a mission that uses RHUs is a special launch service that carries an additional cost against the PI Managed Mission Cost (see Section 5.9.2 and Requirement 82).

5.2.6 Telecommunications, Tracking, and Navigation

Use of NASA's Ground Network, Space Network, or Deep Space Network (DSN) may be proposed, as appropriate. Points of contact and cost information for these services may be found in the *NASA's Mission Operations and Communications Services* document (Program Library).

A cost estimation algorithm for the DSN and persons to contact to obtain costs for other networks and various Government operated facilities are contained in the *NASA's Mission Operations and Communications Services* document or at the DSN Future Missions Planning Office website at http://deepspace.jpl.nasa.gov/advmiss/. For assistance with the cost calculation, contact the persons named on the website.

When the use of non-NASA communication services is proposed, NASA reserves the option of contracting for those services directly through its Space Communication and Navigation (SCaN) office. Further information may be obtained from the point of contact in the *NASA's Mission Operations and Communications Services* document.

Requirement 28. Proposals shall include mission requirements for telecommunications, tracking, and navigation; proposals shall also include a plan for meeting those requirements, including a cost plan, where the cost of development and use of telecommunications, tracking, and navigation services must be included within the PI-Managed Mission Cost cap whether or not NASA networks are used.

Where the use of NASA's network services is clearly within the capabilities and capacities described in the *NASA's Mission Operations and Communications Services* document, no Letter of Commitment is required from the NASA network provider.

Where the use of NASA's network services may not be within the capabilities and capacities described in the *NASA's Mission Operations and Communications Services* document, discussions should be initiated with the Point of Contact (POC) named in that document. In this case, a Letter of Commitment is required from the NASA network provider describing the network's ability to deliver the required capabilities and capacities and the cost for doing so.

Requirement 29. If use of NASA's network services is proposed, costs for services, as described in the *NASA's Mission Operations and Communications Services* document, must be included in the proposal's cost plan.

Requirement 30. If use of NASA's network services beyond the capabilities and capacities described in the *NASA's Mission Operations and Communications Services* document is proposed, the proposal shall include a Letter of Commitment from the NASA network provider; the Letter should confirm the ability of the network to provide the required capabilities and capacities and should include an estimate of the additional costs for these capabilities and capacities.

5.2.7 Critical Event Coverage

Critical events in the operation of a spacecraft are defined as those that could lead to early loss or significant degradation of mission if not executed successfully (or not recovered from quickly in the event of a problem).

NPR 8705.4, *Risk Classification for NASA Payloads*, requires that critical event telemetry be recovered for reconstruction of an anomaly, should one occur. Included in critical events planning are timelines allowing for problem identification, generation of recovery commands and up-linking in a timely manner to minimize risk to the in-space assets. NPR 8705.4 provides examples of critical events. Critical event coverage may be provided in any fashion that is most appropriate for the proposed investigation.

Requirement 31. Proposals shall specify all critical events for the proposed mission and shall discuss the technical approach, required resources, and implementation concepts for providing critical event telemetry.

5.2.8 End-of-Mission Spacecraft Disposal Requirement

NPR 8715.6, *NASA Procedural Requirements for Limiting Orbital Debris*, specifies that spacecraft are to limit the generation of orbital debris during operations and spacecraft disposal requirements for all Earth- and Moon-orbiting spacecraft. Earth-orbiting spacecraft must be passivated at the end of the mission prior to disposal and be deorbited within 25 years post mission (or 30 years after launch, whichever comes first), or be placed in a disposal orbit above 2000 km but not within 300 km of geosynchronous orbit (GEO). Lunar missions must address disposal to avoid increasing the hazard to other spacecraft. Please note that NASA prefers powered controlled reentries for disposal.

Requirement 32. As applicable for Earth and Moon orbiters, proposals shall demonstrate satisfaction of the orbit disposal requirement by providing a mission lifetime analysis and indicating whether disposal is in-orbit or with a reentry, either controlled or uncontrolled (see Appendix B, Section J.7, for additional detail).

5.2.9 Deviations from Recommended Payload Requirements

AO OPTION: <<PROGRAM NAME>> missions selected are required to meet the requirements for safety, reliability, and mission assurance in the <<PROGRAM

NAME>> *Safety, Reliability, and Quality Assurance Requirements* document (see Program Library).

Requirement 33. Proposals shall indicate any expected deviations from the recommended requirements in the <<PROGRAM NAME>> *Safety, Reliability, and Quality Assurance Requirements* document and in Appendix B of NPR 8705.4 for the payload class specified in Section 4.1.3.

5.3 Management Requirements

See Appendix B, Section G, for additional detail.

5.3.1 Principal Investigator

The Mission PI is accountable to NASA for the success of the investigation, with full responsibility for its scientific integrity and for its execution within committed cost and schedule. Designation of a deputy PI is recommended, but not required.

The Mission PI must be prepared to recommend project termination when, in her/his judgment, the minimum subset of science objectives identified in the proposal as the Threshold Science Mission (Section 5.1.3) is not likely to be achieved within the committed cost and schedule.

Requirement 34. Proposals shall identify and designate one, and only one, Mission PI as the individual in charge of the proposed investigation.

5.3.2 Project Manager

The Project Manager (PM) oversees the technical and programmatic implementation of the project. The PM works closely with the PI in order to ensure that the mission meets its objectives within the resources outlined in the proposal.

NASA will approve the PM at each transition to the next Phase of implementation as part of the KDP approval process.

Requirement 35. Proposals shall identify a single Project Manager as the individual charged with the responsibility for overseeing the technical and programmatic implementation of the proposed project.

Requirement 36. Proposals shall clearly define the respective roles of the PI and PM.

5.3.3 Management and Organization Experience and Expertise

The qualifications and experience of the PI, PM, Project Scientist (PS), Project Systems Engineer (PSE), and other key members of the PI-led Investigation Team must be commensurate with the technical and managerial needs of the proposed investigation.

The implementing institutions, selected and overseen by the PI, have the responsibility to ensure that the mission meets schedule and cost constraints. It is the PM and the

implementing institutions' responsibility to provide the quality personnel and resources necessary to meet the technical and managerial needs of the mission. The commitment, spaceflight experience, and past performance of the PI and of the implementing institutions will be assessed against the needs of the investigation.

Requirement 37. Proposals shall identify which management positions will be filled by key management team members (including as a minimum the PI, PM, PSE, and, where appropriate, PS and partner leads). Proposals shall describe the qualifications and experience of the key management team members, where named, and shall demonstrate that the qualifications and experience are commensurate with the technical and managerial needs of the proposed investigation.

Requirement 38. Proposals shall describe the qualifications and experience of the primary implementing institutions and demonstrate that they are commensurate with the technical and managerial needs of the proposed investigation.

5.3.4 Risk Management

Proposers must demonstrate clear understanding of specific risks inherent in the development and implementation of their proposed investigation and must discuss their approaches to mitigating these risks. Examples of such risks that must be discussed in the proposal are: any new technologies, or any nontrivial modifications or upgrades of existing technologies, proposed for the investigation; any manufacturing, test, or other facilities needed to ensure successful completion of the proposed investigation; any need for long-lead items that must be placed on contract before the beginning of Phase C to ensure timely delivery; and any contributions that are critical to the success of the mission.

Requirement 39. Proposals shall define and discuss the major risks to the development and implementation of the proposed investigation.

Requirement 40. Proposals shall discuss management approaches to mitigate risks to ensure successful achievement of the investigation objectives within the committed cost and schedule.

The differences between the Baseline Science Mission and the Threshold Science Mission (see Section 5.1.4) may provide some resiliency to potential cost and/or schedule growth in the proposed development and implementation of the investigation. One method of responding to such growth is to descope the mission. A descope is any alteration of a mission that renders it unable to accomplish one or more of the Baseline Science Mission science objectives. Any set of descopes, which still allows the investigation to satisfy the objectives of the Threshold Science Mission, may be proposed.

Requirement 41. If the proposed risk management approach includes potential descoping of mission capabilities, the proposal shall include a discussion of the approach

to such descopes, including savings of resources (mass, power, dollars, schedule, etc.) by implementing descopes, and the decision milestone(s) for implementing descopes.

Proposals that include international participation must address the risk resulting from any international contributions to the proposed mission (see Section 5.6.7 and Section 5.7).

5.3.5 Compliance with Procurement Regulations by NASA PI Proposals

Proposals submitted by NASA Centers are required to comply with regulations governing proposals submitted by NASA PIs (NASA FAR Supplement (NFS) 1872.308). Additional instructions may be found in Procurement Information Circular (PIC) 05-15 at http://www.hq.nasa.gov/office/procurement/regs/pic.html.

Requirement 42. Proposals submitted by NASA Centers shall contain any descriptions, justifications, representations, indications, statements, and/or explanations that are required by the regulations in NFS 1872.308 (see Appendix B, Section J.8, for additional detail).

5.4 Science Team, Co-Investigators and Collaborators

5.4.1 Science Team

Requirement 43. Proposals shall clearly define the science team necessary to successfully conduct the science investigation.

5.4.2 Co-Investigators

A Co-Investigator (Co-I) is defined as an investigator who plays a necessary role in the proposed investigation and whose services are either funded by NASA or are contributed by his/her employer.

Every Co-I must have a role that is required for the successful development of the mission, and the necessity of that role must be justified. The identification of any unjustified Co-Is may result in the downgrading of an investigation and/or the offer of only a partial selection by NASA.

Requirement 44. Proposals shall designate all Co-Is, describe the role of each Co-I in the development of the mission, and justify the necessary nature of the role.

Requirement 45. Proposals shall identify the funding source for each Co-I. If funded by NASA, costs shall be included in the PI-Managed Mission Cost. If contributed, the costs shall be included in the Total Mission Cost.

5.4.3 Collaborators

A collaborator is an individual who is less critical to the successful development of the mission than a Co-I. A collaborator must not be funded through the proposal. A collaborator may be committed to provide a focused contribution to the project for a specific task, such as data analysis. If funding support is requested in the proposal for an

individual, that individual must not be identified as a collaborator, but must be identified as a Co-Investigator or another category of team member.

Requirement 46. Proposals shall identify and designate all collaborators.

5.5 Small Business Participation and Education and Public Outreach

5.5.1 Small Business Participation

It is the policy of the Government when contracts are issued to emphasize subcontracting opportunities for small businesses. Offerors are advised that NASA is subject to statutory goals to allocate a fair portion of its contract dollars to small businesses, small disadvantaged business (SDB) concerns, HBCUs, and OMIs, as these entities are defined in Federal Acquisition Regulations (FAR) 52.219-8 and 52.226-2. Offerors are encouraged to assist NASA in achieving these goals by using best efforts to involve these entities as subcontractors to the fullest extent consistent with efficient performance of their investigations.

Offerors are advised that, by law, for NASA prime contracts resulting from this solicitation which offer subcontracting possibilities, exceed $500,000, and are with organizations other than small business concerns, the clause at FAR 52.219-9 will apply. Offerors other than small businesses submitting a proposal are advised that a small business subcontracting plan is required with goals for subcontracting with small business (SB), small disadvantaged business (SDB), veteran-owned small business (VOSB), service-disabled veteran-owned small business (SDVOSB), HUB Zone small business (HBZ), women-owned small business (WOSB), Historically Black College and University (HBCU), and Other Minority Institution (OMI) entities to the maximum practicable extent.

If offerors are able to demonstrate that subcontracting opportunities are not reasonably available in the performance of the Phase A concept studies, then subcontracting plans are not required for evaluation of Step 1 proposals leading to Phase A awards for project formulation.

Requirement 47. Proposals shall include a small business subcontracting plan for the Phase A concept study or demonstrate that one is not required (see Appendix B, Section I.1 for additional detail).

At the time the Phase A concept study report is delivered and, regardless of whether subcontracting plans are submitted with the Step 1 proposal, offerors other than small business concerns are required to submit small business subcontracting plans, covering Phases B/C/D/E/F. Failure to submit a subcontracting plan will make the offeror ineligible for subsequent implementation and operation phases. As part of the Step 2 continuation (downselect) decision process, these subcontracting plans will be evaluated on the participation goals and quality and level of work performed by small business concerns overall, as well as that performed by the various categories of small business concerns listed in FAR 52.219-9, except for SDBs. Offerors will separately identify and will be evaluated on participation targets of SDBs in North American Industry

Classification System (NAICS) codes determined by the Department of Commerce to be underrepresented industry sectors.

5.5.2 Core E/PO Program

Among NASA's strategic goals is to communicate the results of its efforts to the American public and to enhance the science and technical education of the next generation of Americans. All selected investigations will be required to implement a core Education and Public Outreach (E/PO) program consistent with SMD policy (see the *Explanatory Guide to the NASA Science Mission Directorate Educational and Public Outreach Evaluation Factors* document in the Program Library). However the quality of E/PO plans is not a consideration in the selection of Step 1 proposals for Phase A concept studies. Therefore, E/PO plans are not needed at this time. Detailed plans for E/PO programs are neither required nor permitted in proposals.

A plan for a core E/PO program will be developed during the Phase A concept study and will be included in the Concept Study Report. The quality of the E/PO plan contained in the Concept Study Report will be evaluated and will be a factor in the down-selection for flight following Phase A; see *The Explanatory Guide to the NASA Science Mission Directorate Educational and Public Outreach Evaluation Factors* in the Program Library.

The minimum allowable core E/PO program cost is defined to be 1% of the PI-Managed Mission Cost [AO OPTION], but excluding any additions to the cost cap owing to TBD (see Section X.Y.Z) [END AO OPTION]. Missions must designate at least the minimum allowable core E/PO program cost for implementation of the core E/PO program. There is no maximum allowable cost for the core E/PO program; however, the funding for the core E/PO program must be included in the PI-Managed Mission Cost.

Requirement 48. Proposals shall not designate an E/PO lead and proposals shall not include a plan for a core E/PO program.

Requirement 49. Proposals shall identify the funding set aside for the implementation of a core E/PO program; this funding shall be at least the minimum allowable core E/PO program cost and shall be included in the PI-Managed Mission Cost.

Requirement 50. Proposals shall include the following statement of commitment from the PI (see Appendix B, Section I.2, for additional detail):

> "I understand the NASA SMD requirements for E/PO and I am committed to carrying out a core E/PO program that meets the goals described in the *Explanatory Guide to the NASA Science Mission Directorate Educational and Public Outreach Evaluation Factors* document. I will submit an E/PO plan with my Concept Study Report if this proposal is selected."

5.5.3 Student Collaborations (optional)

Proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. A SC can take the form of an instrument development, an investigation of scientific questions, analysis and display of data, development of supporting hardware or software, or other aspects of the investigation. The SC must be incorporated into the mission on a nonimpact basis. That is, the SC may not increase the mission development risk or impact the development or performance of the baseline science investigation in any way that would cause the baseline mission to be compromised in the event that the SC component is not funded; encounters technical, schedule, or cost problems; or fails in flight. A SC must be dependent upon the proposed mission being implemented, *e.g.*, require the provision of flight elements and/or access to science/engineering data generated by the mission. SC elements that involve only analysis of archival data may not be proposed. A SC may, but is not required to, have the potential to add value to the science or engineering of the mission. A SC must include appropriate plans for the mentoring and oversight of students to maximize the opportunity for teaching, learning, and success in contributing to the mission.

Although any proposed SC is an E/PO element, a SC may not be used as a component of the core E/PO program. If a proposed investigation is selected, NASA retains the option to fund or not to fund any proposed SC.

There is no minimum and no maximum allowable cost for a SC. NASA is providing a student collaboration incentive that is defined to be 1% of the PI-Managed Mission Cost Cap [AO OPTION] but excluding any additions to the cost cap owing to TBD (see Section X.Y.Z) [END AO OPTION]. The proposed cost of the SC, up to the student collaboration incentive, may be outside of the PI-Managed Mission Cost. If the SC costs more than the student collaboration incentive, then the rest of the cost of the SC must be within the PI-Managed Mission Cost.

In the Step 1 evaluation, a proposed SC will be evaluated only for its impact on mission feasibility. The merit of the proposed SC will not be evaluated in the Step 1 evaluation; the merit of the proposed SC will be evaluated as part of the evaluation of the Step 2 Concept Study Report; see *The Explanatory Guide to the NASA Science Mission Directorate Educational Merit Evaluation Factors for Student Collaboration Elements* in the Program Library.

Requirement 51. If a proposal contains a SC, the proposal shall demonstrate that the proposed SC is clearly separable from the proposed Baseline and Threshold Science Mission investigations, to the extent that the SC will not impact the science investigation in the event that the SC is not funded, that the SC fails during flight operations, or that the SC encounters technical, schedule, or cost problems during development (see Appendix B, Section I.3, for additional detail).

Requirement 52. If a proposal contains a SC, the proposal shall identify the funding set aside for the SC; this funding may be outside the PI-Managed Mission Cost up to the

student collaboration incentive, and any SC costs beyond the student collaboration incentive shall be within the PI-Managed Mission Cost.

5.6 Cost Requirements

5.6.1 PI-Managed Mission Cost and Total Mission Cost

The PI-Managed Mission Cost, including all mission phases, excluding the cost of launch vehicles (Section 5.9.2), is capped at $<<NUMBER>> FY <<YEAR>> dollars.

Requirement 53. Proposals shall include the proposed PI-Managed Mission Cost and the proposed Total Mission Cost in all required AO cost tables (see Appendix B, Section H, for required AO cost tables).

Requirement 54. The proposed costs shall comply with the specified PI-Managed Mission Cost cap.

Requirement 55. No more than 25% of the proposed costs may be spent prior to KDP-C (Confirmation).

5.6.2 Cost of the Phase A Concept Study

Proposers selected through this AO will be awarded a contract to conduct a Phase A concept study with a duration of approximately <<NUMBER>> months. The cost of the Phase A concept study is capped at $<<NUMBER>> Real Year (RY) dollars. See Sections 7.4.2 and 7.4.3 for additional information on the Phase A concept study.

Requirement 56. Proposals shall include the cost of the Phase A concept study, which shall be included within the PI-Managed Mission Cost, and the proposed cost shall comply with the Phase A concept study cost cap.

The unique mission management approaches and organizational arrangements in the selected proposals may require the Program Office to implement varying contract administration and funding arrangements.

Requirement 57. Proposals shall specify the proposed teaming arrangements for the Phase A concept study, including any special contracting mechanisms that are advantageous for specific partners in the team. If more than one contractual arrangement between NASA and the proposing team is required, proposals shall identify how funds are to be allocated among the partnering organizations.

5.6.3 Cost Estimating Methodologies and Cost Reserve Management

As the provision of cost details is not anticipated until the conclusion of concept studies, proposals may use estimates derived from models or cost estimating relationships from analogous missions (see Appendix B, Section H, for additional detail).

Requirement 58. Proposals shall identify the methodologies (cost models, cost estimating relationships of analogous missions, etc.) and rationale used to develop the proposed cost.

Requirement 59. Proposals shall include a discussion of sources of estimate error and uncertainty in the proposed cost and management approaches for controlling cost growth.

Proposals that are unable to show adequate unencumbered cost reserves are likely to be judged a high cost risk and not selected. For the purpose of this AO, the unencumbered cost reserves on the PI-Managed Mission Cost are measured as a percentage against the cost to complete through Phases A/B/C/D. The numerator is the amount of unencumbered cost reserves, not including funded schedule reserve. The denominator is the PI-managed mission cost to complete Phases A-D, including the cost of technical design margin, including funded schedule reserve.

Adequate unencumbered cost reserves are a minimum of 25%. Adequate unencumbered cost reserves must be demonstrated at each of the following milestones: KDP-A (demonstrated in the proposal), KDP-B (demonstrated in the Phase A Concept Study Report), KDP-C (the independent cost estimate for Confirmation), and KDP-D (at the end of Phase C).

Requirement 60. Proposals shall justify the adequacy of the proposed cost reserves, given that the proposed cost is not allowed to increase beyond the cost cap during Phase A or at any later time. Proposals shall comply with the requirement for unencumbered cost reserves against the cost to complete and shall demonstrate an approach to maintaining required unencumbered cost reserves through subsequent development phases.

5.6.4 Work Breakdown Structure

Requirement 61. Proposals shall provide a Work Breakdown Structure (WBS) that conforms to the standard prescribed in Appendix G of NPR 7120.5D. Costs for most elements shall be specified to WBS Level-2. Exceptions are the costs of elements which explicitly appear only at a level below WBS Level-2; these exceptions include individual instruments, unique flight system elements, the use of NASA or NASA-procured tracking and communications, and data analysis/archiving (see Appendix B, Section H, for additional detail).

5.6.5 Master Equipment List

Requirement 62. Proposals shall include a Master Equipment List (MEL) summarizing all flight element subsystem components and individual instrument element components to support validation of proposed mass estimates, design heritage, and cost (see Appendix B, Section J.9, for additional detail).

5.6.6 Full Cost Accounting for NASA Facilities and Personnel

Proposal budgets from NASA Centers, whether as the proposing organization or as a supporting organization, are to include within the PI-Managed Mission Cost all costs that

will be paid out of the resulting award. NASA Civil Service direct labor, travel, and other direct costs are to be included within the PI-Managed Mission Cost, consistent with current Agency full cost practice. Demand service pools are to be included within the proposed PI-Managed Mission Cost.

For the purpose of calculating the full cost of NASA provided services for proposals submitted in response to this AO, the CM&O burden should be applied only to NASA provided labor including Center civil servants and on-site contractors; this cost must be included in the PI-Managed Mission Cost.

Other costs which are not paid with <<Program Name>> Program funds such as Corporate General and Administrative (G&A) estimates, the CM&O burden on off-site contracts (pass-through dollars) and other cost elements, and allocated service pools should not be included within the cost proposal nor within the PI-Managed Mission Cost.

Requirement 63. Proposals including costs for NASA Centers shall conform to the full cost policy stated in Section 5.6.6. Each of the elements of the NASA Center costs (direct labor, travel, other direct costs, demand service pools) shall be separately identified.

Any NASA funded item(s) or services considered as contributed costs must be separately funded by a non-SMD effort complementary to the proposed investigation.

Requirement 64. If any NASA funded item(s) or services are considered as contributed costs, the proposal shall identify the funding source(s).

Any non-NASA Federal Government elements of proposals must follow the appropriate agency accounting standards for full cost. If no standards are in effect, the proposers must follow the Managerial Cost Accounting Standards for the Federal Government as recommended by the Federal Accounting Standards Advisory Board.

Requirement 65. Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

5.6.7 Contributions

Contributions from sources other than the <<Program Name>> Program and other SMD programs, U.S. or non-U.S., are welcome. These may include, but are not limited to, labor, services, and/or contributions to the instrument complement or the spacecraft, subject to the following exceptions and limitations: (i) contributions of non-U.S. nuclear power sources are prohibited; and (ii) in order to ensure a preponderance of NASA interest in the mission, as well as to ensure that missions of roughly comparable scope are proposed for purposes of equitable competition, the sum of contributions of any kind to the entirety of the investigation is not to exceed one-third (1/3) of the proposed PI-Managed Mission Cost. Such contributions will not be counted against the PI-Managed Mission Cost, but they must be included in the calculation and discussion of the Total Mission Cost (Section 4.3).

Values for all contributions of property and services must be established in accordance with applicable cost principles. The cost of contributed hardware must be estimated as either: (i) the cost associated with the development and production of the item, if this is the first time the item has been developed and if the mission represents the primary application for which the item was developed; or (ii) the cost associated with the reproduction and modification of the item (*i.e.,* any recurring and mission-unique costs), if this is not a first-time development. If an item is being developed primarily for an application other than the one in which it will be used in the proposed investigation, then it may be considered as falling into the second category (with the estimated cost calculated as that associated with the reproduction and modification alone).

The cost of contributed labor and services must be consistent with rates paid for similar work in the proposer's organization. The cost of contributions does not include funding spent before the start of the investigation (*i.e.,* before initiation of Phase B). The value of materials and supplies must be reasonable and must not exceed the fair market value of the property at the time of the contribution.

Requirement 66. If a proposal includes one or more contributions, the proposal shall identify all contributions, the organizations providing the contributions, and the organizations providing the funding for the contributions; the costs for the contributions shall be clearly identified within the Total Mission Cost.

Requirement 67. If a proposal includes one or more contributions, the total value of the contributions shall be established in accordance with the applicable and stated cost principles and shall comply with the stated cap on the sum of all contributions.

Letters of Commitment are required from each organization responsible for a contribution (for U.S. organizations, see Section 5.8.1.1 and Requirement 76; for non-U.S. contributing organizations, see Section 5.7.2 and Requirement 70).

The requirement for institutional Letters of Commitment for contributions does not apply to contributed support for Co-Investigators; no institutional Letters of Commitment are required with the Step 1 proposal for contributed Co-Investigator support. The requirement for personal statements of commitment from contributed Co-investigators is given in Section 5.8.1.3 and Requirement 78.

A contributed item that is essential for the success of the proposed investigation and/or is in the critical path of mission development is a risk factor. Risks include the failure of funding or contributions to materialize when they are outside the control of the PI. Mitigation may include, but is not limited to, descoping the contributed items and/or holding reserves to develop the contribution directly. When no mitigation is possible, this should be explicitly acknowledged (see Appendix B, Section H, for additional detail).

Requirement 68. If a proposal includes contributions that are essential to the success of the proposed investigation or in the critical path, the proposal shall include:
(i) demonstrations of clear and simple technical and management interfaces in the

proposed cooperative arrangements, (ii) explicit evidence that the proposed contributions are within the contributors' scientific and technical capabilities, and (iii) contingency plans for coping with potential failures of proposed cooperative arrangements.

5.7 Non-U.S. Participation Requirements

5.7.1 Overview of Non-U.S. Participation

NASA solicits research proposals from both U.S. and non-U.S. sources (see NFS 1835.016-70).

NASA's policies for international cooperation in space research projects may be found in NPD 1360.2A, *Initiation and Development of International Cooperation in Space and Aeronautics Programs*. The characteristics of successful international cooperation include mutual benefits, clearly defined division of responsibilities, responsibilities for each participant within known capabilities, recognition of export control laws prohibiting the unwarranted transfer of technology abroad, and no-exchange-of-funds. Because space research projects generally involve major investments of resources, and because NASA is a Government agency, NASA's counterparts will generally be non-U.S. Government agencies rather than non-U.S. universities or private organizations.

Owing to NASA's policy to conduct research with non-U.S. entities on a cooperative, no-exchange-of-funds basis, NASA does not normally fund non-U.S. research proposals or non-U.S. research efforts that are part of U.S. research proposals. Rather, cooperative research efforts are normally implemented via agreements between NASA and the appropriate non-U.S. entity. Non-U.S. proposers, whether as primary proposers or as participants in U.S. research efforts, are expected to arrange for non-U.S. financing for their portion of the research.

5.7.2 General Guidelines Applicable to Non-U.S. Proposals and Proposals including Non-U.S. Participation

All non-U.S. proposals will undergo the same evaluation and selection process as those originating in the U.S. All proposals, U.S. and non-U.S., must be typewritten in English and must comply with all submission requirements stated in this AO and in Appendix B of this AO.

Requirement 69. Unless otherwise noted, proposals from non-U.S. entities shall not include a cost plan unless the proposal involves collaboration with a U.S. institution, in which case a cost plan that covers only the participation of the U.S. entity shall be included.

Requirement 70. Proposals from non-U.S. entities and proposals from U.S. entities that include non-U.S. participation shall be formally endorsed, through Letters of Commitment, by the responsible funding agency in the country of origin. The required elements in a Letter of Commitment for a contribution are given in Section 5.8.1. In addition to these required elements, endorsements from foreign entities shall indicate that the proposal merits careful consideration by NASA and that, if the proposal is selected,

sufficient funds will be made available to undertake the proposed activity. Officials who are authorized to commit the resources of the non-U.S. funding agencies must sign these Letters of Commitment.

Contributions from non-U.S. sources offer benefits but also represent complexity and risk to a project.

Requirement 71. Proposals from U.S. proposers shall include a discussion of mitigation plans, where possible, for the failure of funding or contributions to materialize when they are outside the control of the PI.

Mitigation may include, but is not limited to, descoping the contributed items and/or holding reserves to develop the contribution directly. Note that reserves held for this purpose will be considered by NASA to be encumbered. When no mitigation is possible, this must be explicitly acknowledged. In addition to budget and technical risk, non-U.S. contributions introduce schedule risk for implementing agreements, as well as for obtaining any necessary licenses for exchanges of goods and technical data. An adequate and realistic schedule must be allocated for having international agreements executed. NASA will not normally initiate development of any international agreements until after the downselect decision is made at the conclusion of Phase A.

Any proposed non-U.S. participation must be described at the same level of detail as that of U.S. partners, including the provision of technical, schedule, and management data. Failure to document technical and schedule data, management approaches, or failure to document the commitment of team members or funding agencies, may cause a proposal to be found unacceptable.

Requirement 72. Any proposed non-U.S. contribution essential to the success of the proposed investigation shall be described at the same level of detail as those of U.S. partners.

Requirement 73. Proposals with non-U.S. participation shall include a table listing: (i) non-U.S. participants (individuals, institutions), (ii) roles and responsibilities, (iii) funding organization, (iv) approximate value of contribution and method for estimating value, and (v) cross-reference to any Letters of Commitment in the proposal appendix. Proposals with non-U.S. participation must clearly describe the flow of design requirements (potentially export controlled information) and hardware between U.S. and non-U.S. participants. This description may take the form of a flowchart. See Section J.4 of Appendix B.

5.7.3 Agreements with Selected Non-U.S. Participants

Should a non-U.S. proposal or a U.S. proposal with non-U.S. participation be selected, NASA's Office of External Relations will arrange with the non-U.S. sponsor for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsor will each bear the cost of discharging its respective responsibilities.

It is the policy of NASA to establish formal agreements with non-U.S. partners in cooperation on flight missions. Owing to the short duration of the concept study phase, it is not possible for NASA to conclude an international agreement prior to the due date for Concept Study Reports. Additionally, in some cases, interim agreements may be put in place until a more permanent arrangement is reached.

Requirement 74. If applicable, proposals shall show how the Phase A concept study can be completed in the absence of an international agreement.

5.7.4 Export Control Guidelines Applicable to Non-U.S. Proposals and Proposals including Non-U.S. Participation

Requirement 75. Non-U.S. proposals and domestic proposals that include non-U.S. participation shall describe plans for compliance with U.S. export laws and regulations, *e.g.,* 22 CFR Parts120-130 and 15 CFR Parts 730-774, as applicable to the circumstances surrounding the particular non-U.S. participation (see Appendix B, Section J.5, for additional detail).

5.8 Additional Proposal Requirements

5.8.1 Letters of Commitment

Letters of Commitment signed by an institutional official must be provided from (i) all organizations offering contributions of goods and/or services (both U.S. and non-U.S., but excluding Co-I services) on a no-exchange-of-funds basis including all non-U.S. organizations providing hardware or software to the investigation (see Section 5.6.7) and (ii) all major organizational partners in the proposal regardless of source of funding. See Appendix B, Section J.2, for additional detail.

The required elements in an institutional Letter of Commitment for a contribution are: (i) evidence that the institution and/or appropriate Government officials are aware and supportive of the proposed investigation; (ii) a precise description of what is being contributed by the partner and what assumptions are being made about NASA's role; (iii) a statement that the organization intends to provide the contribution or required funding for the investigation if it is selected by NASA; (iv) the strongest possible statement of financial commitment from the responsible organization to assure NASA that all contributions will be provided as proposed including whether the contribution and/or funding has been approved and/or what further decisions must be made before the funding is committed by the partner; and (v) a signature by an official authorized to commit the resource of the organization for participation in the investigation (if it is not clear from the signer’s title that the signer has the necessary authority, then the signer’s authority should be explicitly stated in the Letter).

The required elements in an institutional Letter of Commitment for a major partner are: (i) a statement of commitment for the effort that is assigned to that participant in the proposal, (ii) a description of what is being provided, and (iii) a signature by an official authorized to commit the organization.

5.8.1.1 Letters of Commitment for Contributions

An institutional Letter of Commitment for a contribution must contain the required elements described in Section 5.8.1.

Requirement 76. For all U.S. organizations offering contributions, proposals shall include appropriate Letters of Commitment from both the organization(s) providing any contributed property or service and from the organization(s) providing any required funding.

The requirement for Letters of Commitment from non-U.S. organizations offering contributions is given in Section 5.7.2 and Requirement 70.

5.8.1.2 Letters of Commitment for Major Partners

Major partners are the organizations, other than the proposing organization, responsible for providing science leadership, project management, system engineering, major hardware elements, science instruments, integration and test, mission operations, and other major products or services as defined by the proposer. All other participants are regarded as not major. Major partners are listed in Section (i) of the Table of Proposal Partners (see Appendix B, Section J.1, for additional detail).

An institutional Letter of Commitment for a major partner must contain the required elements described in Section 5.8.1.

Requirement 77. Unless otherwise explicitly exempted elsewhere in this AO (*e.g.*, Section 5.2.6), proposals shall include a Letter of Commitment from each major partner in the proposal regardless of source of funding. For major partners providing one or more contributions, only a single Letter of Commitment is required.

5.8.1.3 Personal Letters of Commitment

No personal or institutional Letters of Commitment are required for co-investigators or other proposal team members in the Step 1 proposal. A proposal team member is defined to be any individual identified on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) proposal cover page. Proposal team members indicate their commitment to the proposed investigation through NSPIRES (see Appendix B, Section A.3, for instructions). Requirements to provide personal and institutional Letters of Commitment in Step 2 Concept Study Reports are given in the *Guidelines and Criteria for the Phase A Concept Study* document (Program Library).

Requirement 78. Every proposal team member shall indicate his/her commitment to the proposed investigation, and specifically to the role and responsibilities proposed for him/her, through NSPIRES.

5.8.2 Export Controlled Material in Proposals

Under U.S. law and regulations, spacecraft and their specifically designed, modified, or configured systems, components, and parts are generally considered "Defense Articles"

on the United States Munitions List and are, therefore, subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130.

While inclusion of export controlled material in proposals is not prohibited, proposers are advised that the inclusion of such material in proposals may complicate NASA's ability to evaluate proposals, as NASA may employ the services of non-U.S. citizens, who are not lawful permanent residents of the U.S., to review proposals submitted in response to this AO. In order to enable proper evaluation of proposals, any export-controlled information subject to ITAR must be marked with a notice to that effect.

Requirement 79. If the proposal contains export controlled material, the following statement shall be prominently displayed in Section A of the proposal (following the Proposal Summary Information):

> "The information (data) contained in [insert page numbers or other identification] of this proposal is (are) subject to U.S. export laws and regulations. It is furnished to the Government with the understanding that it will not be exported without the prior approval of the proposer under the terms of an applicable export license or technical assistance agreement."

Note that it is the proposer's responsibility to determine whether any proposal information is subject to the provisions of ITAR. Information about U.S. export regulations is available at http://www.pmddtc.state.gov/ and at http://www.bis.doc.gov/.

5.9 Program Specific Requirements and Constraints

5.9.1 Schedule Requirements

Requirement 80. Proposals shall propose a launch readiness date no later than <<LAUNCH BY DATE>>.

5.9.2 Launch Services

A <<Program Name>> investigation will be launched as the primary payload on an expendable launch vehicle (ELV) that NASA will provide as Government Furnished Equipment (GFE). Standard launch services utilizing a domestic launch vehicle certified by NASA as appropriate for the risk tolerance of the payload will be provided at no charge to the PI-Managed Mission Cost cap. There will be a charge against the PI-Managed Mission Cost for any launch services beyond the standard launch services offered. Detailed information on launch vehicle options, including a description of standard launch services and the nominal costs for non-standard services, is provided in the *Launch Services Information Summary* document in the Program Library.

Funds allocated to the PI-Managed Mission Cost cap cannot be used to purchase a launch vehicle or standard launch services.

AO OPTION: Co-manifested or secondary payloads on a U.S. or non-U.S. launch vehicle cannot be proposed or considered under this AO.

Requirement 81. Proposals shall define the required launch vehicle capability and demonstrate that it is compatible with the standard launch services offered.

Requirement 82. If services beyond the standard launch services offered are required, the proposal shall include the cost of such services in the PI-Managed Mission Cost.

Launch delay costs as a result of spacecraft or payload delays are not a standard launch service. Any such launch delay costs must be funded out of the PI-Managed Mission Cost and, therefore, represent a cost risk to the PI-Managed Mission Cost.

AO OPTION 1: No contributions allowed

Contributed launch services cannot be proposed or considered under this AO.

AO OPTION 2: Contributions of launch services allowed

The provision of launch services, as a contribution to a <<Program Name>> mission by a U.S. or non-U.S. partner, can be proposed only if the following requirements are met: (i) The contributed launch services must be provided on a no-exchange-of-funds basis (*i.e.*, at no cost to SMD). (ii) The value of the contributed launch services must be within the constraint on contributions (see Section 5.6.7). (iii) The proposer must secure the organization(s) that will contribute launch services. (iv) The proposer must identify the launch opportunity in the proposal and must provide evidence in the proposal that the launch service provider agrees to manifest the mission should the proposal be selected and confirmed for flight by NASA. (v) For any co-operative contributed launch services, the approach for NASA's insight for launch services must be submitted in the proposal. Contributed launch services will be handled by NASA consistent with existing policy and regulations. The demonstrated reliability and the resultant probability of mission success for contributed launch services will be evaluated by NASA consistent with *U.S. Space Transportation Policy* (see Section 5A) and NASA's Launch Services Risk Mitigation Policy (NPD 8610.7D, *NASA Launch Services Risk Mitigation Policy for NASA-Owned or NASA-Sponsored Payloads/Missions*). The contributed launch service will be assessed in conjunction with NASA stakeholders as part of the selection process. The NASA Flight Planning Board will approve final mission assignment assuring consistency with Agency risk strategy. Information on the reliability of ELVs may be obtained from the point of contact listed in the *Launch Services Information Summary* (Program Library).

Requirement 83. If a contributed launch service is proposed, the proposal shall demonstrate compliance with all of the requirements for contributed launch services given in Section 5.9.2.

AO OPTION - include if applicable: Because the launch services market is volatile, NASA cannot ensure which launch capabilities will be available at the time of the launch deadline specified in Section 5.9.1. Accordingly, proposers are advised to plan for compatibility with vehicle families expected to be available through spacecraft PDR (see

the *ELV Launch Services Information Summary* in the Program Library). It is recommended that payload designs accommodate launch environments for these vehicle families.

Requirement 84. AO OPTION - include if applicable: Proposals shall discuss flexibility to be accommodated on multiple launch vehicle classes.

5.9.3 Technology Infusion

AO OPTION – Program specific language.

5.9.4 Program Infrastructure Requirements and Opportunities

AO OPTION – Program specific language.

6. Proposal Submission Information

6.1 Preproposal Activities

6.1.1 Preproposal Conference

A Preproposal Conference will be held in <<LOCATION>>, in accordance with the schedule in Section 3. Further information, including logistics, will be available at the <<Program Name>> Acquisition Homepage (see Section 6.1.4) prior to the Preproposal Conference.

All interested parties may attend. All expenses and arrangements for attending this meeting are the responsibility of the attendees. Note that travel and associated costs of attendance are not allowable as direct costs under another Federal Government award, *e.g.,* a contract, grant, or cooperative agreement. Government employees may attend and be authorized travel and associated costs as a matter of official business.

The purpose of this conference will be to address questions about the proposal process for this AO. Questions should be sent to the <<Program Name>> Program Scientist at the address given in Section 6.1.5. NASA personnel will address all questions that have been received no later than five working days prior to the Conference. Questions submitted after this date may be addressed at the Conference as time permits and as appropriate answers can be generated. Anonymity of the authors of all questions will be preserved. Presentations made at the Preproposal Conference, including answers to all questions addressed at the conference, will be posted on the <<Program Name>> Acquisition Homepage listed above approximately two weeks after this event. Additional questions and answers subsequent to the conference will also appear in this location, if necessary.

6.1.2 Notice of Intent to Propose

To assist the planning of the proposal evaluation process, NASA strongly encourages all prospective proposers to submit a Notice of Intent (NOI) to propose, before the NOI submittal deadline specified in Section 3. Material in a NOI is deemed confidential and will be used for NASA planning purposes only. Submission of a NOI is not required for the submission of a proposal to this solicitation. Those who submit NOIs will receive any

<<Program Name>> Program updates or AO amendments that may occur, up to the time of the proposal submittal deadline (see also Section 6.1.4).

A NOI is submitted electronically by entering the requested information at http://nspires.nasaprs.com/. Registration on the NSPIRES website is required to submit NOIs and proposals. Proposers who experience difficulty in using the NSPIRES site should contact the Help Desk by E-mail at nspires-help@nasaprs.com for assistance.

The following information (to the extent that it is known by the NOI due date) is requested for the NOI:

(a) Name, address, telephone number, fax number, E-mail address, and institutional affiliation of the PI.
(b) Full names and institutional affiliations of each known Co-I. If any Co-Is or other proposal team members are from non-U.S. institutions, the vehicle by which these people expect to be funded should be identified in the comments box on the NOI form.
(c) Anticipated launch-vehicle performance class.
(d) A brief statement (150 words or less) for each of the following:
    (i) science objectives of the proposed mission;
    (ii) identification of new technologies that may be employed as part of the mission.
(e) The name of the Lead Representative from each organization (industrial, academic, nonprofit, and/or Federal) included in the proposing team as may be known at the time of the NOI.

6.1.3 Teaming Interest

As a result of recent AOs similar to this one, commercial aerospace and technology organizations have requested a forum to inform potential proposers of their services and/or products. NASA is willing to offer this service with the understanding that the Agency does not endorse any information thus transmitted and does not accept responsibility for the capabilities or actions of these organizations. The organizations listed on the <<Program Name>> Teaming Interest page of the <<Program Name>> Acquisition Homepage (see address given in Section 6.1.4) have expressed interest in teaming with other organizations on <<Program Name>> proposals. This is not a comprehensive list of organizations that are capable of teaming; it is simply a list of those organizations that have asked to be included. Proposers are not required to team with any organization on this list.

6.1.4 Program Library and Acquisition Home Page

The <<Program Name>> Program Library provides additional regulations, policies, and background information on the <Program Name>> Program. Information on the Program Library is contained in Appendix D. The Program Library is accessible at <<Program Library URL>>.

A <<Program Name>> Acquisition Homepage, available at <<Acquisition Homepage URL>>, will provide updates and any AO addenda during the <<Program Name>> AO

solicitation process. It will provide links to the Program Library, information about the preproposal conference, a list of potential proposers and teaming partners, and questions and answers regarding the AO.

Updates to the AO and any amendments will be posted on the NSPIRES website. A link will be provided on the <<Program Name>> Acquisition Homepage to the NSPIRES index page for the AO.

6.1.5 Point of Contact for Further Information

Inquiries about this AO may be directed to the <<Program Name>> Program Scientist:

Dr. (NAME)
(NAME) Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone: 202-358-<<NUMBER>>
E-mail: (NAME)@nasa.gov

6.2 Proposal Preparation and Submission

6.2.1 Structure of the Proposal

General NASA guidance for proposals is given in Appendix A of this AO, which is considered binding unless specifically amended in this AO. A uniform proposal format is required from all proposers to aid in proposal evaluation. The required proposal format and contents are summarized in Appendix B. Failure to follow Appendix B may result in reduced ratings during the evaluation process or, in some cases, could lead to rejection of the proposal without review.

Requirement 85. Proposals shall conform to the uniform proposal format outlined in Appendix B.

6.2.2 Certifications

The authorizing institutional signature on the proposal certifies that the proposing institution has read and is in compliance with the three required certifications printed in full in Appendix G. Therefore, it is not necessary to separately submit these certifications with the proposal.

If the certifications need to be amended, they may be submitted as an additional proposal appendix.

6.2.3 Submission of Proposals

Requirement 86. The original signed proposal and <<NUMBER OF COPIES>> paper copies, each of which contains an attached, clearly labeled CD-ROM that contains electronic proposal files (see Appendix B), shall be delivered to the following address by the proposal submittal deadline specified in Section 3. [Partially repeats Requirement 1]

<<Program Name>> AO
Science Mission Directorate
NASA Research and Education Support Services
Suite 200
500 E Street, SW
Washington, DC 20024-2760
Tel: (202) 479-9030

NASA will notify proposers that their proposals have been received. Proposers who have not received this confirmation within two weeks after submittal of their proposals should contact the <<Program Name>> Program Scientist at the address given in Section 6.1.5.

Proposals received after the submittal deadline will be treated in accordance with Appendix A, Section VII.

6.2.4 Electronic Submission of Proposal Summary Information

This AO requires that proposal summary information, referred to as the Electronic Cover Page, must be submitted electronically to NSPIRES, NASA's master proposal database system located at http://nspires.nasaprs.com/. This data site is secure and all information entered is strictly for NASA's use.

Potential proposers should access this site well in advance of the proposal due date to familiarize themselves with its structure and to enter the requested identifier information. Every individual named as a proposal team member on the proposal's Electronic Cover Page must be registered in NSPIRES. Such individuals must register themselves; that is, no one may register a second party, even the PI of a proposal in which that person is committed to participate. The proposal's Electronic Cover Page must be submitted electronically by one of the officials at the proposing organization who is authorized to make such a submission. Every organization that intends to submit a proposal to NASA in response to this AO must be registered in NSPIRES. Such registration must be performed by the organization's Electronic Business Point-Of-Contact (EBPOC) in the Central Contractor Registry (CCR).

Requirement 87. The proposing organization and all individuals named as proposal team members on the Electronic Cover Page shall be registered in NSPIRES.

All proposal team members shall indicate their commitment to the proposed investigation through NSPIRES (see Requirement 78).

The same proposal summary information must be submitted on the Electronic Cover Page as is in Section A of the proposal. The Electronic Cover Page may be submitted either before or after the proposal is submitted, as long as the Electronic Cover Page is submitted no later than the proposal due date given in Section 3. This means that the Electronic Cover Page may be finalized after the proposal is completed to ensure that the Electronic Cover Page has identical information as Section A of the proposal.

Alternatively the Electronic Cover Page may be submitted first and a printout of the Electronic Cover Page may be included in Section A of the proposal.

Requirement 88. The Electronic Cover Page shall contain information that is identical to the information contained in Section A of the proposal.

Requirement 89. The Electronic Cover Page shall be submitted in NSPIRES by an authorized organizational representative (AOR) of the proposing organization, and it shall be submitted by the proposal submittal deadline specified in Section 3. [Partially repeats Requirement 2]

Frequently Asked Questions (FAQs) on the use of NSPIRES can be accessed through the NSPIRES Proposal Online Help site at http://nspires.nasaprs.com/external/help.do.

Additional instructions for submitting the Electronic Cover Page are given in Appendix B, Section A.2.

7. Proposal Evaluation, Selection, and Implementation

7.1 Overview of the Proposal Evaluation and Selection Process

7.1.1 Evaluation Process

All proposals will be initially screened to determine their compliance to requirements and constraints of this AO. Additional compliance checks occur during the evaluation process. Proposals that do not comply may be declared noncompliant and returned to the proposer without further review. A submission compliance checklist is provided in Appendix F. This checklist provides proposers a list of the items that NASA will check for compliance before releasing a proposal for evaluation. This checklist is for the convenience of proposers; it is not required to be submitted as part of a proposal.

Compliant proposals will be evaluated against the criteria specified in Section 7.2 by panels of individuals who are peers of the proposers. Proposals will be evaluated by more than one panel (*e.g.*, a science panel and a technical/management/cost panel); each panel will evaluate proposals against different criteria. Panel members will be instructed to evaluate every proposal independently without comparison to other proposals. These panels may be augmented through the solicitation of nonpanel (mail in) reviews, which the panels have the right to accept in whole or in part, or to reject.

Proposers should be aware that, during the evaluation and selection process, NASA may request clarification of specific points in a proposal; if so, such a request from NASA and the proposer's response must be in writing. In particular, before finalizing the evaluation of the feasibility of the mission implementation (see Section 7.2.4), NASA will request clarification on specific, potential major weaknesses in the feasibility of mission implementation that have been identified in the proposal. NASA will request such clarification uniformly from all proposers. The ability of proposers to provide clarification to NASA is extremely limited, as NASA does not intend to enter into

discussions with proposers. A typical limited response is to direct NASA's attention to pertinent parts of the proposal without providing further elaboration.

7.1.2 Categorization and Steering Process

An *ad hoc* categorization subcommittee of the SMD AO Steering Committee, composed wholly of Civil Servants and Intergovernmental Personnel Act appointees (some of whom may be from Government agencies other than NASA) and appointed by the Associate Administrator for the Science Mission Directorate, will convene to consider the peer review results and, based on the evaluations, categorize the proposals in accordance with procedures required by NFS 1872.403-1(e). The categories are defined as follows:

Category I. Well conceived and scientifically and technically sound investigations pertinent to the goals of the program and the AO's objectives and offered by a competent investigator from an institution capable of supplying the necessary support to ensure that any essential flight hardware or other support can be delivered on time and data that can be properly reduced, analyzed, interpreted, and published in a reasonable time. Investigations in Category I are recommended for acceptance and normally will be displaced only by other Category I investigations.

Category II. Well-conceived and scientifically or technically sound investigations which are recommended for acceptance, but at a lower priority than Category I.

Category III. Scientifically or technically sound investigations which require further development. Category III investigations may be funded for development and may be reconsidered at a later time for the same or other opportunities.

Category IV. Proposed investigations which are recommended for rejection for the particular opportunity under consideration, whatever the reason.

A sitting panel of the SMD AO Steering Committee will then review the results of the evaluations and categorizations. The AO Steering Committee will conduct an independent assessment of the evaluation and categorization processes regarding their compliance to established policies and practices, as well as the completeness, self-consistency, and adequacy of all supporting materials.

7.1.3 Selection Process

After the review by the AO Steering Committee, the final evaluation results will be presented to the Associate Administrator for the Science Mission Directorate, who will make the final selection(s). As the Selection Official, the SMD Associate Administrator may consult with senior members of SMD and the Agency concerning the selections.

As part of the selection decision, a decision will be made as to whether or not any Category III proposals will receive funding for technology development.

7.2 Evaluation Criteria

7.2.1 Overview of Evaluation Criteria

The evaluation criteria, which are defined more fully in the following sections and will be used to evaluate proposals as described in Section 7.1.1, are as follows:

- The scientific merit of the proposed investigation;
- The scientific implementation merit and feasibility of the proposed investigation; and
- The technical, management, and cost (TMC) feasibility of the proposed approach for mission implementation, including cost risk.

The proposal categorizations, discussed in Section 7.1.2, will be based on these criteria. For categorization, scientific merit is weighted approximately 40%, scientific implementation merit and feasibility is weighted approximately 30%, and TMC feasibility, including cost risk, is weighted approximately 30%.

These criteria are defined more fully in the following sections. Evaluation findings for each evaluation criterion will be documented with narrative text in the form of specific major and minor strengths and weaknesses, as well as an adjectival summary score. The adjectival summary scores for the first two criteria (scientific merit and scientific implementation merit) will be reported as Excellent, Very Good, Good, Fair, or Poor, as defined in the table below.

Summary Evaluation	**Basis for Summary Evaluation**
Excellent	A comprehensive, thorough, and compelling proposal of exceptional merit that fully responds to the objectives of the AO as documented by numerous and/or significant strengths and having no major weaknesses.
Very Good	A fully competent proposal of very high merit that fully responds to the objectives of the AO, whose strengths fully outbalance any weaknesses.
Good	A competent proposal that represents a credible response to the AO, having neither significant strengths nor weakness and/or whose strengths and weaknesses essentially balance.
Fair	A proposal that provides a nominal response to the AO but whose weaknesses outweigh any perceived strengths.
Poor	A seriously flawed proposal having one or more major weaknesses (*e.g.*, an inadequate or flawed plan of research or lack of focus on the objectives of the AO).

The third criterion, technical merit and feasibility, including cost risk, will be reported as Low Risk, Medium Risk, or High Risk, as defined in the table below.

Summary Evaluation	**Basis for Summary Evaluation**
Low Risk	There are no problems evident in the proposal that cannot be normally solved within the time and cost proposed. Problems are not of sufficient magnitude to doubt the Proposer's capability to accomplish the investigation well within the available resources.
Medium Risk	Problems have been identified, but are considered within the proposal team's capabilities to correct within available resources with good management and application of effective engineering resources. Mission design may be complex and resources tight.
High Risk	One or more problems are of sufficient magnitude and complexity as to be deemed unsolvable within the available resources.

7.2.2 Scientific Merit of the Proposed Investigation

The information provided in a proposal will be used to assess the intrinsic scientific merit of the proposed investigation. Scientific merit will be evaluated for the Baseline Science Mission and the Threshold Science Mission; science enhancements options beyond the Baseline Science Mission will not contribute to the assessment of the scientific merit of the proposed investigation. The factors for scientific merit include the following:

- Factor A-1. Compelling nature and scientific priority of the proposed investigation's science goals and objectives. This factor includes the clarity of the goals and objectives; how well the goals and objectives reflect program, Agency, and National priorities; the potential scientific impact of the investigation on program, Agency, and National science objectives; and the potential for fundamental progress, as well as filling gaps in our knowledge relative to the current state of the art.
- Factor A-2. Programmatic value of the proposed investigation. This factor includes the unique value of the investigation to make scientific progress in the context of other ongoing and planned missions; the relationship to the other elements of NASA's science programs; how well the investigation may synergistically support ongoing or planned missions by NASA and other agencies; and the necessity for a space mission to realize the goals and objectives.
- Factor A-3. Likelihood of scientific success. This factor includes how well the anticipated measurements support the goals and objectives; the adequacy of the anticipated data to complete the investigation and meet the goals and objectives; and the appropriateness of the mission requirements for guiding development and ensuring scientific success.
- Factor A-4. Scientific value of the Threshold Science Mission. This factor includes the scientific value of the Threshold Science Mission using the standards

in the first factor of this section and whether that value is sufficient to justify the proposed cost of the mission.

Factors A-1 through A-3 are evaluated for the Baseline Science Mission assuming it is implemented as proposed and achieves technical success. Factor A-4 is similarly evaluated for the Threshold Science Mission.

This evaluation will result in narrative text, including specific major and minor strengths and weaknesses, as well as an appropriate adjectival rating for the scientific merit of the investigation.

7.2.3 Scientific Implementation Merit and Feasibility of the Investigation

The information provided in a proposal will be used to assess merit of the plan for completing the proposed investigation including the scientific implementation merit, feasibility, resiliency, and probability of scientific success of the proposed investigation. The factors for scientific implementation merit and feasibility include the following:

- Factor B-1. Merit of the instruments and mission design for addressing the science goals and objectives. This factor includes the degree to which the proposed mission will address the goals and objectives; the appropriateness of the selected instruments and mission design for addressing the goals and objectives; the degree to which the proposed instruments and mission can provide the necessary data; and the sufficiency of the data gathered to complete the scientific investigation.
- Factor B-2. Probability of technical success. This factor includes the maturity and technical readiness of the instruments; the adequacy of the plan to develop the instruments within the proposed cost and schedule; the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks; the likelihood of success in developing any new technology that represents an untested advance in the state of the art; the ability of the development team - both institutions and individuals - to successfully implement those plans; and the likelihood of success for both the development and the operation of the instruments within the mission design.
- Factor B-3. Merit of the data analysis plan. This factor includes the merit of plans for data analysis and data archiving to meet the goals and objectives, to result in the publication of science discoveries in the professional literature, and to leave a data archive of value to the science community. Considerations in this factor include an assessment of planning and budget adequacy and evidence of plans for well-documented, high-level products and software usable to the entire science community, consideration of adequate resources for physical interpretation of data and reporting scientific results in refereed journals, and assessment of the proposed plan for the timely release of the data to the public domain for enlarging its science impact.
- Factor B-4. Science resiliency. This factor includes both developmental and operational resiliency. Developmental resiliency includes the approach to descoping the Baseline Science Mission to the Threshold Science Mission in the

event that development problems force reductions in scope. Operational resiliency includes the ability to withstand adverse circumstances, the capability to degrade gracefully, and the potential to recover from anomalies in flight.

- Factor B-5. Probability of science team success. This factor will be evaluated by assessing the experience, expertise, and organizational structure of the science team and the mission design in light of any proposed instruments. The role of each Co-Investigator will be evaluated for necessary contributions to the proposed investigation; the inclusion of Co-Is who do not have a well defined role may be cause for downgrading of the proposal.
- Factor B-6. Merit of any science enhancement options (SEOs), if proposed. This factor includes assessing the appropriateness of activities selected to enlarge the science impact of the mission; the potential of the selected activities to enlarge the science impact of the mission; and the appropriate costing of the selected activities. The peer review panel will inform NASA whether the evaluation of the proposed SEOS impacted the overall rating for scientific implementation merit and feasibility. Lack of an SEO will have no impact on the proposal's overall rating for scientific implementation merit and feasibility.

Student Collaboration proposals, if any, will be evaluated only for the impact they have on science implementation feasibility to the extent that they are not separable; student collaboration proposals will not be penalized in Step 1 for any inherent higher cost, schedule, or technical risk, as long as the student collaboration is shown to be clearly separable from the implementation of the Baseline Science Mission. The intrinsic merit of student collaborations will not be evaluated at this time.

This evaluation will result in narrative text, including specific major and minor strengths and weaknesses, as well as an appropriate adjectival rating for the scientific implementation merit and feasibility of the scientific investigation.

7.2.4 Feasibility of the Mission Implementation, Including Cost Risk

The technical and management approaches of all submitted investigations will be evaluated to assess the likelihood that they can be successfully implemented as proposed, including an assessment of the likelihood of their completion within the proposed cost and schedule. The factors for feasibility of mission implementation include the following:

- Factor C-1. Adequacy and robustness of the technical plan. This factor includes assessment of implementation elements such as: the overall mission design and mission architecture; the spacecraft design and design margins; the plan for communication and navigation/tracking; and the proposer's understanding of the processes, products, and activities required to accomplish development and integration of all elements (flight systems, ground and data systems, etc.). This factor includes mission resiliency – the flexibility to recover from problems during both development and operations – including the technical resource reserves and margins, system and subsystem redundancy, and changes and descopes which can be implemented without impact to the Baseline Science

Mission. The reliability of the proposed launch vehicle will be evaluated where the launch vehicle is not provided by NASA.

- Factor C-2. Adequacy and robustness of the cost plan and schedule. This factor includes assessment of proposal elements such as cost and cost risk, the adequacy of the approach, the methods and rationale used to develop the estimated cost, the discussion of cost risks, the subcontracting plan, and the team's understanding of the scope of work (covering all elements of the mission, including contributions). Proposals will be evaluated for the adequacy of the cost reserves and whether proposals with inadequate cost reserves demonstrate a thorough understanding of the cost risks. This factor also includes assessment of proposal elements such as the relationship of the work to the project schedule, the project element interdependencies, the associated schedule margins, and an assessment of the likelihood of launching by the proposed launch date. Also evaluated under this factor are the proposed cost and schedule management tools to be used on the project.
- Factor C-3. Adequacy of the management approach including the capability of the management team. This factor includes: the adequacy of the proposed organizational structure; the management approach; the roles, qualifications, and experience of the PI, PM, other named key management team members, and implementing organization, mission management team, and known partners; the commitment, spaceflight experience, and relevant performance of the PI, PM, other named key management team members, and implementing organization, mission management team, and known partners against the needs of the investigation; the commitments of partners and contributors; and the team's understanding of the scope of work covering all elements of the mission, including contributions.
- Factor C-4. Adequacy of the risk management approach. The adequacy of the proposed risk management approach will be assessed, as will any risk mitigation plans for new technologies, any long-lead items, and the adequacy and availability of any required manufacturing, test, or other facilities. The approach to any proposed descoping of mission capabilities will be assessed against the proposed Baseline Science Mission. The plans for managing the risk of contributed critical goods and services will be assessed, including the commitment of partners and contributors as documented in Letters of Commitment and the adequacy of contingency plans for coping with the failure of a proposed cooperative arrangement or contribution.
- Factor C-5. Technical readiness. This factor includes the plans for the development and use of new technology and the adequacy of backup plans to ensure success of the mission when technologies having a TRL less than 6 are proposed. The maturity and technical readiness of the instrument complement, spacecraft, and operations systems will be assessed. The adequacy of the plan to mature systems within the proposed cost and schedule, the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks, and the likelihood of success in developing any new technologies will be assessed.

When appropriate, technical, management, and cost evaluation will include an assessment of proposed planetary protection provisions to avoid potential biological contamination (forward and backward) that may be associated with the mission.

Student Collaboration proposals, if any, will be evaluated only for the impact they have on overall mission feasibility to the extent that they are not separable; student collaboration proposals will not be penalized in Step 1 for any inherent higher cost, schedule, or technical risk, as long as the student collaboration is shown to be clearly separable from the implementation of the baseline mission. The intrinsic merit of student collaborations will not be evaluated at this time.

This evaluation will result in narrative text, including specific major and minor strengths and weaknesses, as well as an appropriate risk rating for the feasibility of mission implementation.

7.3 Selection Factors

As described in Section 7.1.3, the results of the proposal evaluations based on the criteria above and the categorizations will be considered in the selection process.

Considering the critical role of the PI, PM, and their institutions, past performance (especially in meeting cost and schedule constraints) will be an important risk factor in the selection of an investigation under this AO.

The Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals for Phase A study and in selecting among top-rated proposals, including, but not limited to, planning and policy considerations, available funding, and maintaining a programmatic and scientific balance across SMD. While SMD develops and evaluates its program strategy in close consultation with the scientific community through a wide variety of advisory groups, the SMD program is an evolving activity that ultimately depends upon the most current Administration policies and budgets, as well as program objectives and priorities that can change quickly based on, among other things, new discoveries from ongoing missions.

The overriding consideration for the final selection of proposals submitted in response to this AO will be to maximize scientific return and minimize implementation risk while advancing NASA's science goals and objectives within the available budget for this program. Therefore, the proposed PI-Managed Mission Cost will be considered in the final selection of investigations through this AO. Depending on the availability of proposals of appropriate merit, this objective may be achieved by the selection of investigation(s) at the PI-Managed Mission Cost cap for this AO, one or more investigations significantly below the PI-Managed Mission Cost cap that would allow a more rapid release of the next AO, or a combination of investigations of various costs. Proposers are encouraged to propose well below the PI-Managed Mission Cost cap, as that permits greater flexibility and robustness in the Program and in SMD.

7.4 Implementation of Selected Proposals

7.4.1 Notification of Selection

Following selection, the PIs of the selected investigations will be notified by telephone, followed by formal written notification which may include any special conditions or terms of the offer of selection (*e.g.*, partial selections, see Section II of Appendix A) and any special instructions for the Concept Study. The formal notification will also include instructions for scheduling a debriefing at which any issues noted during the evaluation that may require attention during the Phase A concept study will be discussed, as well as instructions for attending the Project Initiation Conference.

7.4.2 Award Administration and Funding

Oversight management responsibilities have been assigned to the <<Program Name>> Program Office at the <<Center Name>> Center. The responsibilities of the Program Office will include oversight of mission implementation, coordination of Government-furnished services, equipment and facilities, and contract management for selected investigations.

It is anticipated that the Program Office will provide funding to each selected investigation, as stated in Section 5.6.2; this award to perform a Phase A concept study is to be initiated as soon as possible after notification of selection. NASA Centers will receive funding via intraagency funding mechanisms. In order to place Phase A awards in place, Statements of Work (SOWs) and cost and pricing data will be required for the Phase A concept studies.

Proposals are <u>not</u> required to include SOWs and cost and pricing data for Phase A concept studies and subsequent phases. These will be required <u>only</u> for investigations that are selected at the outcome of the Step-1 competition. If more than one contractual arrangement between NASA and the proposing team is required, a separate SOW is required for each organization.

For those investigations that are selected, it will be in the best interest of their PI-led mission management teams to provide SOWs and cost and pricing data in as timely a manner as possible. The process of awarding contracts cannot begin until SOWs and cost and pricing data have been received, and funds cannot be provided to the implementing organizations until this process has been completed.

SOWs will be required for selected investigations regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the requirement for a Phase A Concept Study Report as described in the *Guidelines and Criteria for the Phase A Concept Study* document available in the Program Library, as well as general task statements for Phases B through F. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). SOWs need not be more than a few pages in length.

For Phase A contracts that exceed $650K, the contractor will be required to provide cost and pricing data to support the Phase A cost estimate, in the format specified in NPR 5800.1, *Grant and Cooperative Agreement Handbook,* Section A, Exhibit A, and to certify the costs proposed for the Phase A contract in accordance with FAR 15.406-2.

Each contract will contain a priced option for a bridge phase, to be exercised upon investigations down-selected to proceed into Phase B. The bridge phase is intended to cover a four-month period of Phase B effort to provide program continuity while negotiations are completed to modify the contract to include Phases B, C/D, and E/F.

7.4.3 Conduct of the Phase A Concept Study

The concept studies are intended to provide NASA with more definitive information regarding the cost, risk, and feasibility of the investigations, as well as a detailed plan for the conduct of an appropriate education and public outreach program and an optional student collaboration, before final selection for implementation. The product of the concept studies is a Phase A Concept Study Report to be delivered by each selected investigation team <<NUMBER>> months after the Project Initiation Conference. The content and format of the study reports are specified in the *Guidelines and Criteria for the Phase A Concept Study* document in the Program Library.

The PI will provide in the Phase A Concept Study Report a proposed set of Level 1 requirements, including the criteria for full mission success satisfying the Baseline Science Mission and the criteria for minimum mission success satisfying the Threshold Science Mission. The PI-Managed Mission Cost will not increase by more than 20% from that in the Step 1 proposal to that in the Phase A Concept Study Report, and in any case will not exceed the PI-Managed Mission Cost cap. The NASA review of the completed Concept Study Report will include all mission facets, including E/PO. Risk reduction that has been accomplished during Phase A will be closely reviewed. NASA may request presentations and/or site visits to review the final concept study results with the investigators.

7.4.4 Downselection of Investigations

The SMD Associate Administrator will make downselection decisions based on the evaluation of the Phase A Concept Study Reports and on programmatic considerations. The criteria for evaluating the concept study are as follows:

- Scientific merit of the proposed investigation;
- Scientific implementation merit of the proposed investigation;
- Technical, management, and cost feasibility, including cost risk, of the proposed investigation; and
- Merit of plans for E/PO, including any student collaboration proposed.

The evaluation criteria and downselection factors are described in the *Guidelines and Criteria for the Phase A Concept Study* document in the Program Library. Any changes to science and science implementation contained in the Phase A Concept Study Report

will be carefully evaluated. Assuming no changes to the first two criteria, the emphasis during downselection will be on the latter two.

As a result of evaluation of the concept studies, NASA expects to select up to <<NUMBER>> investigation(s) to proceed by exercising the bridge phase option on the selected contract(s). Investigations may be downselected to enter Phase B or may be downselected for a funded Extended Phase A so they can retire one or more risks before it is allowed to proceed to Phase B. For investigations selected to enter phase B immediately, the downselect serves as the Initial Confirmation Review gate (KDP-B); an investigation downselected for an Extended Phase A must subsequently pass an Initial Confirmation Review gate (KDP-B) with the SMD Program Management Council (PMC) before entering Phase B. There is no guarantee that an investigation downselected for an Extended Phase A will be approved to enter Phase B, even if all risks have been retired during the Extended Phase A. In no case, however, is NASA required to exercise any option. NASA will not exercise any contract option nor continue funding those investigations not selected to proceed.

Should a non-U.S. proposal or a U.S. proposal with non-U.S. participation be selected, NASA's Office of External Relations, Science Division, will arrange with the non-U.S. sponsoring agency for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency memorandum of understanding.

The contract or other funding mechanism for further formulation and implementation will conform to all applicable Federal and NASA procurement requirements. A *Draft Model Contract* for Phase B/C/D/E formulation and implementation is available in the Program Library.

7.4.5 Confirmation of Investigations

Per NPR 7120.5D, at the end of Phase B, NASA will conduct an independent review of the investigation's readiness to proceed. This review must be completed before the project will be authorized to spend more than 25% of the proposed PI-Managed Mission Cost. The results of the independent review and the project status will be presented to the SMD Program Management Council (PMC) at the Confirmation Review (KDP-C) for Confirmation to enter Phase C. If the project is classified Category 1 according to NPR 7120.5D, the Confirmation results will need subsequent approval from the Agency PMC. Following Confirmation, no rephasing between fiscal years of Phase E costs to Phase C/D will be permitted.

7.5 Opportunity for Debriefing of Nonselected Proposers

Proposers of investigations that are not selected will be notified in writing and offered oral debriefings for themselves and a representative from each of their main partners (if any). Written debriefing materials will be provided at the time of the oral debriefing.

Such debriefings may be in person at NASA Headquarters or by telephone if the proposal PI prefers. In the former case, please note that all expenses and arrangements for attending a debriefing are the responsibility of the attendee. Travel and associated costs of attendance are not allowable as a direct cost under another Federal Government award, *i.e.*, contract, grant, or cooperative agreement. Government employees may attend and be authorized travel and associated costs as a matter of official business.

7.6 Process for Appeals

7.6.1 Agency Procurement Ombudsman

The Agency Procurement Ombudsman, designated in NPD 5101.32, *Procurement*, will take action to resolve concerns, disagreements, and recommendations submitted by interested parties that cannot be resolved at the Center level, or those having Agencywide implications, refer Center-specific issues to the appropriate Center Procurement Ombudsman for action, and periodically communicate with Center Procurement Ombudsmen on common Agencywide issues and refer those issues to the appropriate office for action. Under NPD 5101.32, the designated Agency Procurement Ombudsman is:

Director of the Contract Management Division
Office of Procurement
NASA Headquarters
Washington, DC 20546
USA

7.6.2 Protests

Only prospective offerors seeking contract awards under this AO have the right to file a protest, either at the Government Accountability Office (GAO) or with the Agency, as defined in FAR 33.101. The provisions at FAR 52.233-2 (“Service of Protest”) and NFS 1852.233-70 (“Protests to NASA”) are incorporated into this AO. Under both of these provisions, the designated official for receipt of protests to the Agency and copies of protests filed with the GAO is:

Assistant Administrator for Procurement
Office of Procurement
NASA Headquarters
Washington, DC 20546
USA

8. Conclusion

The <<Program Name>> Program represents a challenging way for NASA to accomplish important scientific exploration, as well as to generate opportunities to enhance education and engage the public in the excitement of science discoveries. NASA invites both the U.S. and international science communities to submit proposals for <<Program Name>> investigations in response to this Announcement.

<<DIVISION DIRECTOR NAME>>
Director
<<DIVISION NAME>>

<<AA NAME>>
Associate Administrator
for Science Mission Directorate

APPENDIX A

GENERAL INSTRUCTIONS AND PROVISIONS
NASA FAR Supplement, Part 1872.705-1

I. INSTRUMENTATION AND/OR GROUND EQUIPMENT

By submitting a proposal, the investigator and institution agree that NASA has the option to accept all or part of the offeror's plan to provide the instrumentation or ground support equipment required for the investigation, or NASA may furnish or obtain such instrumentation or equipment from any other source as determined by the selecting official. In addition, NASA reserves the right to require use of Government instrumentation or property that subsequently becomes available, with or without modification, that meets the investigative objectives.

II. TENTATIVE SELECTIONS, PHASED DEVELOPMENT, PARTIAL SELECTIONS, AND PARTICIPATION WITH OTHERS

By submitting a proposal, the investigator and the organization agree that NASA has the option to make a tentative selection pending a successful feasibility or definition effort. NASA has the option to contract in phases for a proposed experiment and to discontinue the investigative effort at the completion of any phase. NASA may desire to select only a portion of the proposed investigation and/or that the individual participates with other investigators in a joint investigation. In this case, the investigator will be given the opportunity to accept or decline such partial acceptance or participation with other investigators prior to a NASA selection. Where participation with other investigators as a team is agreed to, one of the team members will normally be designated as its leader or contact point. NASA reserves the right not to make an award or cancel this AO at any time.

III. SELECTION WITHOUT DISCUSSION

The Government intends to evaluate proposals and award contracts without discussions with offerors. Therefore, each initial offer should contain the offeror's best terms from a cost or price and technical standpoint. However, the Government reserves the right to conduct discussions, if later determined by the Contracting Officer to be necessary.

IV. NONDOMESTIC PROPOSALS

The guidelines for proposals originating outside of the United States are the same as those for proposals originating within the United States, except that the additional conditions described in AO Section 5.7 shall also apply.

V. TREATMENT OF PROPOSAL DATA

It is NASA policy to use information contained in proposals and quotations for evaluation purposes only. While this policy does not require that the proposal or quotation bear a restrictive notice, offerors or quoters should, in order to maximize protection of trade secrets or other information that is commercial or financial and confidential or privileged, place the following notice on the title page of the proposal or quotation and specify the information, subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information (data) contained in proposals and quotations will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

RESTRICTION ON USE AND DISCLOSURE OF
PROPOSAL AND QUOTATION INFORMATION (DATA)

> The information (data) contained in (insert page numbers or other identification) of this proposal or quotation constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed for other than evaluation purposes; provided, however, that in the event a contract is awarded on the basis of this proposal or quotation, the Government shall have the right to use and disclose this information (data) to the extent provided in the contract. This restriction does not limit the Government's right to use or disclose this information (data), if obtained from another source without restriction.

VI. STATUS OF COST PROPOSALS

Submission of cost or pricing data, as defined in FAR 15.401, is required if the combined Phase A and Bridge Phase costs exceed $650,000. Cost or pricing data will also be required for proposals for subsequent mission phases. The investigator's institution agrees that the cost proposal submitted in response to the Announcement is for proposal evaluation and selection purposes, and that, following selection and during negotiations leading to a definitive contract, the institution may be required to resubmit or execute all certifications and representations required by law and regulation.

VII. LATE PROPOSALS

The Government reserves the right to consider proposals or modifications thereof received after the date indicated for such purpose, if the selecting official deems it to offer NASA a significant technical advantage or cost reduction. (See NFS 18-15.208.)

VIII. SOURCE OF SPACE INVESTIGATIONS

Investigators are advised that candidate investigations for space missions can come from many sources. These sources include those selected through this AO, those generated by NASA in-house research and development, and those derived from contracts and other agreements between NASA and external entities.

IX. DISCLOSURE OF PROPOSALS OUTSIDE THE GOVERNMENT

NASA may find it necessary to obtain proposal evaluation assistance outside the Government. Where NASA determines it is necessary to disclose a proposal outside the Government for evaluation purposes, arrangements will be made with the evaluator for appropriate handling of the proposal information. Therefore, by submitting a proposal, the investigator and institution agree that NASA may have the proposal evaluated outside the Government. If the investigator or institution desires to preclude NASA from using an outside evaluation, the investigator or institution should so indicate on the cover. However, notice is given that if NASA is precluded from using outside evaluation, it may be unable to consider the proposal.

X. EQUAL OPPORTUNITY

For any NASA contract resulting from this solicitation, the clause at FAR 52.222-26, "Equal Opportunity," shall apply.

XI. PATENT RIGHTS

a. For any NASA contract resulting from this solicitation awarded to other than a small business firm or nonprofit organization, the clause at NFS 18-52.227-70, New Technology, shall apply. Such contractors may, in advance of a contract, request waiver of rights as set forth in the provision at NFS 18-52.227-71, Requests for Waiver of Rights to Inventions.

b. For any NASA contract resulting from this solicitation awarded to a small business firm or nonprofit organization, the clause at FAR 52.227-11, Patent Rights -- Retention by the Contractor (Short Form), (as modified by NFS 18-52.227-11) shall apply.

XII. RIGHTS IN DATA

Any contract resulting from this solicitation will contain the Rights in Data – General clause: FAR 52.227-14.

XIII. SMALL AND SMALL DISADVANTAGED BUSINESS SUBCONTRACTING

a. Offerors are advised that NASA is subject to statutory goals to allocate a fair portion of its contract dollars to SDB concerns, HBCUs, and OMIs, as these entities are defined in 52.219-8 and 52.226-2 of the FAR. Offerors are encouraged to assist NASA in achieving these goals by using best efforts to involve these entities as subcontractors to the fullest extent consistent with efficient performance of their investigations.

b. Offerors are advised that, by law, NASA prime contracts resulting from this solicitation which offer subcontracting possibilities, exceed $500,000, and are with organizations other than small business concerns, the clause at FAR 52.219-9 shall apply. Accordingly, offerors awarded contracts for Phase A concept studies that exceed $500,000 are required to submit small business subcontracting plans consistent with the FAR, covering the study phase only, unless they adequately demonstrate that subcontracting opportunities are not reasonably available in the performance of these concept studies. Failure to do so will make the offeror ineligible for award. These plans should be submitted for negotiation after selection in conjunction with contract execution.

c. As part of the down selection of investigations, offerors, other than small business concerns, are required to submit small business subcontracting plans, covering implementation and operation phases B/C/D/E/F, at the time the Phase A concept study reports are delivered. Failure to submit a subcontracting plan will make the offeror ineligible for award. As part of the down select decision, these subcontracting plans will be evaluated on the participation goals and quality and level of work performed by small business concerns overall, as well as that performed by the various categories of small business concerns listed in FAR 52.219-9, except for SDBs. Offerors shall separately identify and will be evaluated on participation targets of SDBs in North American Industry Classification System (NAICS) codes determined by the Department of commerce to be underrepresented industry sectors.

XIV. WITHDRAWAL OF PROPOSALS

Proposals may be withdrawn by the proposer at any time before award. Proposers are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances that dictate termination of evaluation.

APPENDIX B

REQUIREMENTS FOR PROPOSAL PREPARATION

INTRODUCTION

The following requirements apply to preparation of proposals in response to this Announcement of Opportunity (AO). While the body of the AO specifies the general policies and requirements for preparing Step 1 proposals, as well as for implementing missions proposed in response to this opportunity, Appendix B contains the specific requirements for the format and content of Step 1 proposals. In the event of apparent conflicts between this Appendix and the policies and requirements specified within the body of the AO, the latter takes precedence.

GENERAL REQUIREMENTS

The following expands requirements in the AO, in particular Requirement 85.

Requirement B-1. A proposal shall consist of one volume divided into readily identifiable sections that correspond and conform to Sections A through J of this appendix. It shall be typewritten in English and shall employ metric (SI) and/or standard astronomical units, as applicable. It shall contain all data and other information that will be necessary for scientific and technical evaluations; provision by reference to external sources, such as Internet websites, of additional material that is required for evaluation of the proposal is prohibited.

Requirement B-2. All parts of a proposal, including photographs and/or colored graphics, shall be printed on recyclable white paper. Page size shall be either American standard 8.5 x 11 inches or European standard A4. Foldout pages (11 x 17 inches or A3) may also be employed at the proposers' discretion (see below for assessment of foldout pages against the page limit). Cardboard stock and loose-leaf binders are prohibited; plastic covers and spiral bindings are acceptable.

Requirement B-3. Text shall not exceed 55 lines per page. Margins at the top, both sides, and bottom of each page shall be no less than 1 inch if printed on 8.5 x 11 inch paper; no less than 2.5 cm at the top and both sides, and 4 cm at the bottom if printed on A4 paper. Single-column or double-column formats are acceptable for text pages. Type fonts for text and figure captions shall be no smaller than 12-point (*i.e.*, no more than 15 characters per inch; six characters per centimeter). There is no minimum requirement for fonts used within figures and tables but all text in figures and tables shall be legible; fonts smaller than 8-point are often illegible.

Proposal Structure and Page Limits	
Section	**Page Limits**
A. Graphic Cover Page Proposal Summary Information Optional statements: Export controlled material statement (see Section 5.8.2) Restriction on Use statement (see Appendix A, Section V)	No page limit No page limit 0.5 0.5
B. Fact Sheet	2
C. Table of Contents	No page limit
D. Science Investigation E. Science Implementation, including optional SEO	25 + <<TBD>> page/ instrument + <<TBD>> page for SEO **
F. Mission Implementation G. Management (Schedule foldout	25 + <<TBD>> page/ flight element ** No page limit)
H. Cost and Cost Estimating Methodology (Cost Table B3	8 No page limit)
I. Small Business Subcontracting Plan, Acknowledgement of Education and Public Outreach requirements, Optional Student Collaboration plan	2 + 2 for SC
J. Appendices: (no others permitted) 1. Table of Proposal Participants 2. Letters of Commitment 3. Resumes 4. Summary of Proposed Program Cooperative Contributions 5. Draft International Participation Plan - Discussion on Compliance with U.S. Export Laws and Regulations 6. (AO OPTION) A. Planetary Protection Plan; B. Sample Curation Plan 7. (AO OPTION) Discussion of End-of-Mission Spacecraft Disposal Requirements 8. Compliance with Procurement Regulations by NASA PI Proposals 9. Master Equipment List (MEL) 10. Heritage 11. List of Abbreviations and Acronyms 12. List of References (optional)	No page limit unless otherwise specified, but a minimum number of pages is encouraged

** Total extra pages limited to <<TBD>> as described above; extra pages may be distributed between Sections D-G as desired.

Requirement B-4. Proposals shall conform to the page limits specified in the *Proposal Structure and Page Limits* table. <<TBD>> extra page(s) each is (are) allotted for each separate science instrument, <<TBD>> extra page(s) each is (are) allotted for each separate flight element (*e.g.*, cruise element, landed element, sample return element, additional spacecraft), and <<TBD>> extra page(s) is (are) allotted for all science enhancement options (SEOs) combined, if they are permitted by the AO. The total number of such extra pages shall not exceed a maximum of <<TBD>> extra pages regardless of the number of science instruments and flight elements. Every side of a page upon which printing appears will count against the page limits and, unless specifically exempted (*e.g.*, Requirement B-40 and Requirement B-49), each foldout page will count as two pages against the page limits.

Requirement B-5. One copy of every proposal shall bear on its cover sheet the original signatures of the Principal Investigator and an official of the PI's institution who is authorized to commit its resources (see Section A of this appendix). This "original" copy shall be printed on a single side of each page, and it shall be bound in a manner (*e.g.*, with a binder clip, with a rubber band, in an accordion folder, etc.) that allows it to be disassembled easily for reproduction in the event that NASA needs additional copies. The number of printed "review" copies specified in Section 6.2.3 of this AO shall be submitted with the original copy; two-sided printing is required for the review copies.

Requirement B-6. A CD-ROM containing up to three searchable PDF files of the proposal, limited to the main proposal, all tables, and all applicable appendices (see Section J of this appendix), as well as EXCEL files of tables (see Requirement B-50 and Requirement B-69) shall be attached to the original and to each review copy.

A. GRAPHIC COVER PAGE AND PROPOSAL SUMMARY INFORMATION

A.1 HARDCOPY PROPOSAL

The following expands requirements in the AO, in particular Requirement 85.

Requirement B-7. A Graphic Cover Page and Proposal Summary Information, prepared as directed below, shall preface every proposal. These pages will not be counted against the page limits.

Requirement B-8. The Graphic Cover Page shall contain, at a minimum, the following information and elements displayed on the cover page of the proposal:

- The proposal title;
- The name of the proposing organization;
- The name of the PI;
- The name and title of an official who is authorized to commit the proposing organization through the submission of the proposal;
- The signature of the PI and the authorizing official (unless these signatures appear on the Proposal Summary Information), and

- A 0.5 inch (13 mm) high by 2 inch (51 mm) long space in the upper right corner of the page for NASA to place the proposal number and the copy number.

Optionally, the Graphic Cover Page may also contain:

- Any illustrations or graphic elements of the proposer's choice (or none); and
- Any additional information of the proposer's choice that is non-proprietary and that does not provide additional content beyond what is in the proposal (or none).

Requirement B-9. The Proposal Summary Information shall include the following information and only the following information. This information shall be identical to the information entered into the Electronic Cover Page in NSPIRES (see Requirement B-10). Including a printed copy of the completed NSPIRES Electronic Cover Page in the proposal will satisfy this requirement. These pages will not be counted against the page limits.

- The signature of the PI and the authorizing official (unless these signatures appear on the Graphic Cover Page);
- Section I:
  - The Principal Investigator's (PI's) full name, E-mail address, phone number, and mailing address;
  - The proposal's full title, proposed start date, and proposed end date;
- Section II:
  - The date submitted;
- Section III:
  - The legal name of the proposing organization;
  - The common name ("doing business as" name) of the proposing organization;
  - The Division/Department/Center of the proposing organization;
  - The mailing address of the proposing organization;
- Section IV:
  - The proposal point-of-contact's (POC's) name, E-mail address, and telephone number (proposal POC may be the PI);
- Section V:
  - The following text, verbatim:

> Certification of Compliance with Applicable Executive Orders and U.S. Code
>
> By submitting the proposal identified in the Graphic Cover Sheet/Proposal Summary Information in response to this Announcement of Opportunity, the Authorizing Official of the proposing organization (or the individual proposer if there is no proposing organization) as identified on the cover of this proposal:
> • certifies that the statements made in this proposal are true and complete to the best of his/her knowledge;
> • agrees to accept the obligations to comply with NASA award terms and conditions if an award is made as a result of this proposal; and
> • confirms compliance with all provisions, rules, and stipulations set forth in the three Certifications contained in this AO (namely, (i) the Assurance of Compliance with the NASA Regulations Pursuant to Nondiscrimination in Federally Assisted Programs, (ii) the Certification Regarding Debarment,

Suspension, and Other Responsibility Matters Primary Covered Transactions, and (iii) Certification Regarding Lobbying).

Willful provision of false information in this proposal and/or its supporting documents, or in reports required under an ensuing award, is a criminal offense (U.S. Code, Title 18, Section 1001).

- The name, E-mail address, and phone number of the authorized official who signed the proposal's cover page;

- Section VI:
  - For every proposal team member, their name, E-mail address, phone number, organization name, and team member role (exactly one role per team member) chosen from the following list (note that these are the only roles permitted by NSPIRES; other named key personnel such as project scientist or project systems engineer should use the most appropriate role from this list):

List of Team Member Roles
Principal Investigator
Co-investigator
Co-I/Institutional PI
Collaborator
Project Manager
Industry Partner
International Partner
Other Professional
Postdoctoral Associate
Graduate/Undergraduate Student

- Section VII:
  - Proposal summary (not to exceed 300 words); NASA intends to enter the summaries of all investigation proposals selected for its various programs into a publicly accessible database; proposal summaries shall not contain proprietary or confidential information that the submitters wish to protect from public disclosure;
- Section VIII:
  - Answers to the following questions:
    - Is proprietary/privileged information included in this application? – Answer Yes or No;
    - Does this project involve activities outside the U.S. or partnership with non-U.S. collaborators? – Answer Yes or No;
    - Are NASA civil servant personnel participating as team members on this project (include funded and unfunded)? – Answer Yes or No.
- Section IX:
  - Short title of proposal (the mission's acronym or short nickname);
  - List all science team members, key institutional representatives, and other science participants in this investigation, both requesting funding and not requesting funding, who do not appear in Section VI and on the proposal's electronic cover page as a proposal team member. Include name, institution, city, state or country, and a description of the role in five words or less (*e.g.*, data analyst, facility

provider, support technician). (*N.b.*, this is requested to aid NASA in avoiding conflicts of interest for proposal reviewers.)

- <<Other Program Specific Questions, per AO>>;
- Statement of contributions to development or operations (but not science) by any non-U.S. partner. Identify the non-U.S. partner(s), the non-U.S. funding agency/agencies, and the approximate value of the non-U.S. contributions, if any;
- PI-Managed Mission Cost in real year dollars (RY$) and in FY<<YEAR>> dollars from Table B3;
- Total Mission Cost in real year dollars (RY$) and in FY<<YEAR>> dollars from Table B3;
- Answers to the following questions:
  - This proposal contains information and/or data that are subject to U.S. export control laws and regulations, including Export Administration Regulations (EAR) and International Traffic in Arms Regulations (ITAR). – Answer Yes or No;
  - The export-controlled material (EAR and/or ITAR) has been identified in this proposal. – Answer Yes or No or N/A;
  - The proposer acknowledges that the inclusion of such material in this proposal may complicate the Government's ability to evaluate the proposal. – Answer Yes or No or N/A;
  - Is use of radioactive materials (*e.g.*, radioisotope power sources, radioisotope heater units, or radioactive material sources for science instruments) proposed – Answer Yes or No.

A.2 ELECTRONIC COVER PAGE (NSPIRES Submission)

The following expands requirements in the AO, in particular Requirement 88 and Requirement 89.

Electronic submission must be through the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at http://nspires.nasaprs.com/.

Requirement B-10. This AO requires that proposal summary information, referred to as the Electronic Cover Page, shall be submitted electronically. The forms for the Electronic Cover Page are found in NSPIRES at http://nspires.nasaprs.com/. The Electronic Cover Page shall be completed and submitted online. The electronic submission of the Electronic Cover Page alone does not satisfy the deadline for proposal submission. Electronic submission of the Electronic Cover Page in NSPIRES need not be completed until after the proposal is finalized, but must be completed before the proposal submittal deadline specified in Section 8 of this AO.

Requirement B-11. The same proposal summary information shall be submitted on the Electronic Cover Page as is in Section A of the proposal. In particular, the list of proposal team members and the proposed costs must be identical.

Note that proposers have several options for meeting Requirement B-10 and Requirement B-11: (i) proposers may first finalize, copy, and submit the hardcopy proposal including the Proposal Summary Information and then complete and submit the Electronic Cover Page in NSPIRES; (ii) proposers may first complete and submit the Electronic Cover Page in NSPIRES and then print it out for inclusion in the hardcopy proposal; or (iii) any other order for completing and submitting both the Proposal Summary Information in the hardcopy proposal and the Electronic Cover Page via NSPIRES. Both Requirement B-10 and Requirement B-11 require that the Proposal Summary Information and the Electronic Cover Page contain identical data and that both are received by NASA prior to the proposal deadline no matter what order they are completed and submitted.

A.3 PROPOSAL TEAM MEMBER COMMITMENT THROUGH NSPIRES

The following expands requirements in the AO, in particular Requirement 87.

Every proposal team member (*i.e.*, every individual identified on the NSPIRES proposal cover page) must indicate his/her commitment to the proposed investigation through NSPIRES prior to proposal page submission.

A proposal team member will receive an E-mail from NSPIRES indicating that he/she has been added to the proposal by the PI. The proposal team member should log in to NSPIRES. Once logged in, the proposal team member should follow the link in the "Reminders and Notifications" section of his/her NSPIRES home page, titled "Need Statement of Commitment For: Proposal to Solicitation <<solicitation number>>." On the "Team Member Statement of Commitment – Confirmation" page, the proposal team member should read the commitment language, click the "Accept" button, and then click "OK".

If the address information then displayed on the "Team Member Information" screen does not represent the organization through which the individual proposal team member is participating in this proposal or is out of date, the proposal team member should click the "Account Mgmt" link in the NSPIRES navigation bar across the top and then edit the address book to accurately reflect the organization through which the individual proposal team member is participating in this proposal. Note that the organization through which the proposal team member is participating in the proposal may not be the proposal team member's primary employer or primary mailing address. If the address information is accurate (or once it has been edited to be accurate), the proposal team member may log out of NSPIRES.

The PI may monitor the status of proposal team member commitments by examining the "Commitment Confirmed" column on the Team Member page of the NSPIRES proposal cover page record.

Requirement B-12. Every proposal team member named on the proposal cover page shall personally commit to the proposed investigation through NSPIRES. Every proposal

team member shall ensure that the organization listed on the proposal cover page is the organization through which the proposal team member is participating in the proposal.

B. FACT SHEET

The following expands requirements in the AO, in particular Requirement 85.

Requirement B-13. Every proposal shall include a fact sheet that provides a brief summary of the proposed investigation. Information conveyed on this fact sheet shall include:

- Science objectives (including the importance of the science to the program science goals);
- Mission overview;
- Instrument complement;
- Key spacecraft characteristics;
- Mission management and participating organizations (including teaming arrangements, as known);
- Anticipated need for curatorial services for returned samples, as applicable;
- Schedule summary;
- The proposed PI-Managed Mission Cost in real year dollars (RY$) and in FY<<YEAR>> dollars from Table B3; and
- The proposed Total Cost, including a breakdown of any contributed costs by contributing organization, in real year dollars (RY$) and in FY<<YEAR>> dollars from Table B3.

C. TABLE OF CONTENTS

The following expands requirements in the AO, in particular Requirement 85.

Requirement B-14. Every proposal shall contain a table of contents that conforms to the outlines provided in Sections D through J of this appendix, below.

D. SCIENCE INVESTIGATION

The following expands requirements in the AO, in particular Requirement 3 through Requirement 18.

1. Scientific Background, Goals, and Objectives.

Requirement B-15. This section shall describe the goals and objectives of the investigation, the compelling nature of the investigation, the investigation's value to advancing NASA's science objectives, and the relationship of the proposed investigation to past, current, and future investigations and missions.

2. Science Requirements.

Requirement B-16. This section shall describe the investigation to be performed, the types of measurements to be taken, the characteristics, precision, and accuracy required to attain the scientific objectives, and the projected instrument performance. This section shall describe the data to be returned in the course of the investigation. The quality (*e.g.*, resolution, coverage, pointing accuracy, measurement precision, etc.) and quantity (bits, images, etc.) of data that must be returned shall be described. The relationship between the proposed data products (*e.g.*, flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, sample returns, witness samples, laboratory data, etc.) and the scientific objectives, as well as the expected results, shall be described. How the science products and data obtained will be used to fulfill the scientific requirements shall be demonstrated and supported by quantitative analysis. These descriptions shall constitute the Baseline Science Mission.

Requirement B-17. Traceability from science objectives to measurement requirements to instrument functional requirements, and to top-level mission functional requirements shall be provided in tabular form and supported by narrative discussion. Projected instrument performance shall be compared to instrument functional requirements.

Table B1 of this appendix provides an example of a tabular Science Traceability Matrix, with examples of matrix elements. This matrix provides the reference points and tools needed to track overall mission requirements, provide systems engineers with fundamental requirements needed to design the mission, show clearly the effects of any descoping or losses of elements, and facilitate identification of any resulting degradation to the science.

3. Threshold Science Mission.

Requirement B-18. This section shall identify the minimum acceptable data and scientific return for the mission (the Threshold Science Mission), below which the mission would not be worth pursuing. The Threshold Science Mission is identified with the “Threshold Science Requirements” in NPR 7120.5D. The scientific value of the Threshold Science Mission shall be discussed. NASA recognizes that, in some circumstances, the Threshold Science Mission may be identical to the Baseline Science Mission. In such cases, the proposer shall explain why there is no viable mission below the Baseline Science Mission.

E. SCIENCE IMPLEMENTATION

The following expands requirements in the AO, in particular Requirement 4 through Requirement 18 and Requirement 44 through Requirement 46.

1. Instrumentation.

Requirement B-19. This section shall describe the instrumentation and the rationale for its selection. It shall identify the individual instruments and instrument systems, including their characteristics and requirements, and indicate items that are proposed for development, as well as any existing instrumentation or design/flight heritage. It shall provide a clear understanding of how the concept will provide the required data, show how it can be accommodated by the spacecraft, demonstrate that instruments have the necessary unobstructed fields-of-view over the measurement period required, describe the technology readiness levels and the approach to bring systems to technology readiness level (TRL) 6 at preliminary design review (PDR). If no development plan is needed, the reasons for this shall be explicitly stated and the rationale shall be described. A preliminary description of each instrument design, with a block diagram showing the instrument systems and their interfaces, along with a description of the estimated performance of the instrument, shall be included. These performance characteristics (which shall be considered as requirements on the flight system) shall include mass, power, volume, data rate(s), thermal, pointing (such as control, stability, jitter, drift, accuracy, etc.), spatial and spectral resolution, observable precision, retrieved parameter sensitivity and accuracy, and calibration requirements. This section shall demonstrate that the instrumentation can meet the measurement requirements, including factors such as retrieval results for each remote sensor, error analysis of the information in all sensors, vertical and horizontal resolution, signal-to-noise (S/N) calculations, etc. It shall also discuss effects, such as radiation and contamination, on each instrument's measurement capabilities as a function of mission time.

Requirement B-20. The following information shall be provided for each science instrument proposed:

- Mass (include breakouts of electronics and optics);
- Viewing direction in body coordinates;
- Pointing accuracy and stability requirements
- Operational modes;
- Operational mode timeline;
- Data demand for each instrument operational mode;
- Onboard data processing and storage required from spacecraft;
- Power demand for each instrument operational mode including peak, average, and stand-by power; and
- Instrument thermal control capability.

2. Data Sufficiency.

Requirement B-21. This section shall discuss the quality and quantity of data to be generated by each instrument, as they relate to the proposed science investigation goals and objectives. The flow-down from science investigation goals to measurement objectives and instrument performance shall be stated clearly and supported by quantitative analysis.

3. Science Mission Profile.

Requirement B-22. This section shall discuss the science observing profile, including all mission-relevant parameters, such as orbit, navigation accuracy, operational time lines (including observing periods, data transmission periods and techniques, and time-critical events), etc. The manner in which the proposed investigation objectives, selected instruments, and measurement requirements drive the proposed mission design and operations plan should be apparent from this discussion.

4. Data Plan.

Requirement B-23. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, and archiving shall be described. The science products (*e.g.*, flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, sample returns, witness samples, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the appropriate NASA data archive and the formats and standards to be used. It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community.

5. Science Team.

Requirement B-24. This section shall identify each key member (*i.e.*, one whose participation is essential to the success of the investigation) of the science team and his/her role and responsibilities. Resumes or curriculum vitae of science team members shall be included as appendices to the proposal (see Section J.3 of this appendix). The role of each co-investigator (Co-I) shall be explicitly defined, the necessity of that role shall be justified, and the funding source (NASA or contributed) for the PI and each Co-I shall be noted. Non-funded members of the science team shall be identified in the proposal as collaborators (see Section 5.4 of this AO). The role of collaborators may be defined and justified.

6. Plan for Science Enhancement Options (SEO).

Requirement B-25. If an SEO is proposed, this section shall define and describe the proposed activities (see Section 5.1.6 of this AO).

F. MISSION IMPLEMENTATION

The following expands requirements in the AO, in particular AO Requirement 18 through Requirement 24.

1. General Requirements and Mission Traceability.

Requirement B-26. This section shall provide a description of the spaceflight mission that is proposed to enable the science investigation.

In some areas *(e.g.,* instruments), the data requested may have already been presented in another section of the proposal (*e.g.*, the Science Implementation section). In such a case, a proposal may provide a reference to that section and need not repeat the data in this section.

Requirement B-27. The mission functional requirements that the science goals and objectives impose on the mission design elements, including mission design, instrument accommodation, spacecraft design, required launch vehicle capability, ground systems, communications approach, and mission operations plan, shall be provided in tabular form and supported by narrative discussion. Table B2 provides an example of a tabular Mission Traceability Matrix, with examples of matrix elements. Specific information that describes how the science investigation imposes unique requirements on these mission design elements shall be included.

This matrix, along with Table B1, provides the reference points and tools needed to track overall mission requirements, provides systems engineers with fundamental requirements needed to design the mission, show clearly the effects of any descoping or losses of mission elements, and facilitates identification of any resulting degradation to the science.

Requirement B-28. NASA recognizes that the full depth of information requested in Requirement B-29 through Requirement B-40 may not be available for some aspects of mission implementation at this stage of mission design. In such cases, this section shall (i) describe the current design concept, (ii) explain why the design information is not complete, (iii) provide a time-based plan for completing the design, (iv) justify that the development of that aspect of the design is not required at this stage and that it is acceptable to develop details later, and (v) explain why the lack of information at this stage does not translate into a risk to the proposer's ability to implement the mission as proposed. The approach for developing the required depth of information, along with a corresponding development schedule, shall be included among the plans for future activity. In cases where a mission is proposed at or near the cost cap, but depth of technical implementation detail is deferred, the proposal shall justify the adequacy of the proposed cost reserves to prevent increases beyond the cost cap during Phase A and subsequent phases.

This requirement is levied to establish NASA's standard for completeness of information necessary to support a comprehensive assessment of implementation feasibility and risk. The quality of the proposal's response to this requirement contributes significantly to the quality of the TMC assessment. However, NASA recognizes the preliminary nature of Step 1 proposals, and thus Requirement B-28 will apply to all cases where the required information cannot, for whatever reason, be provided.

2. Mission Concept Descriptions.

Requirement B-29. Designs for all elements of the mission shall be described in sufficient detail to demonstrate that the proposed concept meets all of the basic requirements for a space flight mission, including mission design, spacecraft design, and supporting ground systems. Discussion of how the various mission elements meet the Mission Functional Requirements shall be included. At a minimum, the following mission elements shall be addressed: mission design, flight system capabilities, mission operations, and any additional elements.

Requirement B-30. Mission Design: This section shall address the following elements of mission design to the extent that they are applicable to the proposed mission and that they are known at the time of proposal submission. Any additional elements that are applicable to explaining the mission and demonstrating its feasibility shall also be addressed.

- Launch readiness date (including launch date flexibility);
- Mission duration;
- Orbit type (Earth orbit, heliocentric, etc.) and orbit information (semimajor axis, eccentricity, inclination, node time of day, argument of perigee, altitude), and/or trajectory design, as applicable to the proposed investigation;
- Critical events; and
- Ground station(s) usage (*e.g.* location(s), and transmitting and receiving communication parameters).

Requirement B-31. Launch Vehicle Compatibility: Compatibility with the proposed launch vehicle shall be demonstrated by providing in the appropriate proposal section the launch site, fairing size, spacecraft mass, mission orbit characteristics such as altitude, (km – circular or apogee/perigee) inclination, C3, heliocentric and/or declination (DLA). Describe any known non-standard requirements such as additional fairing doors, cleanliness and purge requirements, planetary protection, etc.

Requirement B-32. Flight System Capabilities: This section shall address the following flight system capabilities to the extent that they are applicable to the proposed mission and that they are known at the time of proposal submission. Any additional elements that are applicable to explaining the mission and demonstrating its feasibility shall also be addressed.

- Spacecraft Parameters:

(a) Figure of the complete spacecraft/instrument system, on the launch vehicle and in-flight, with major components labeled and approximate overall dimensions.
(b) Block diagram of the spacecraft subsystems and their components.

- Subsystem descriptions including structure, telecommunications, thermal, power, propulsion (if required), attitude determination and control, command and data handling, flight software, and ground software. (Note that the discussion of the telecommunications subsystem should be limited to specifications, design, and proposed component hardware – discussion of the link performance is addressed as part of the mission operations approach). Subsystem detail shall include to the extent possible the following information:
  (a) Propulsion including (i) Delta-V budget; (ii) for each propulsion mode propulsion type(s) (monoprop, bi-prop, dual-mode, solar electric, etc.), engines and thrust levels, and specific impulse; propellant allocation (impulse vs. attitude control system); (iii) propellant margin including nominal (to meet Delta-V requirement) and additional (to meet mass growth).
  (b) Command and Data Handling including (i) spacecraft housekeeping data rates for nominal and safing strategy; (ii) data storage unit size (Mbits); (iii) maximum storage record and playback rate.
  (c) Power

AO Option 1: Deep Space, including Heliocentric Orbit Missions:
(i) identify type of array structure (rigid, flexible, body mounted); (ii) solar array axes of rotation (vector projected in spacecraft coordinates); (iii) array size; (iv) solar cell type and efficiency; (v) expected power generation at Beginning of Life and End of Life; (vi) worst case Sun incidence angle to solar panels during science mission; (vii) battery type and storage capacity; (viii) worst case battery Depth of Discharge (DOD); (ix) spacecraft bus voltage.

AO Option 2: Earth and Lunar Orbiter Missions, and Earth-Sun L1/L2:
(i) expected power requirement for each mission phase; (ii) minimum power capability needed to meet all requirements; (iii) associated battery Depth of Discharge (DOD).

(d) Attitude Determination and Control, including system pointing requirements and capabilities. Describe or define the following: (i) each spacecraft operational mode including the sensors and actuators used, control method, and safing and/or contingency modes; (ii) attitude determination methodology and estimate of accuracy including identifying whether ground post-processing is required to meet science needs; (iii) agility requirements for slews or scanning; (iv) appendage pointing requirements including articulation control methods and deployment accommodations; (v) sensor selection and performance including identifying mounting location and field-of-view (FOV); (vi) actuator selection and sizing including identifying mounting location(s); (vii) translational maneuver (Delta-V) control and accuracy; (viii) momentum management approach and mitigation of impacts on navigation accuracy, if applicable; (ix) on-orbit calibrations, if required, including expected accuracy; (x) attitude control requirements for the spacecraft pointing control, pointing knowledge (at the instrument interface), pointing stability or jitter.

(e) Thermal control, including (i) temperature requirements, (ii) temperature control approach (*i.e.* passive *vs.* active), and (iii) special thermal design considerations (*e.g.*, cryogenic instrument requirements).

Requirement B-33. Additional Mission Elements: This section shall address any other major mission elements (*i.e.*, lander, upper-stage, etc.) to the extent that they are applicable to the proposed mission and to the extent that they are known at the time of proposal submission. Any additional elements that are applicable to explaining the mission and demonstrating its feasibility shall also be discussed.

- Provide a block diagram and description of relevant subsystems; and
- Demonstrate that the proposed design can accomplish the mission within the allocated resources.

Requirement B-34. Flight System Contingencies and Margins: This section shall summarize contingencies and margins of all key flight systems resources. For the driving mission element requirements derived from the Mission Functional Requirements, it should provide estimates of implementation performance and design margins with respect to the required performance. At a minimum, it shall include the following:

- Mass;
- Propellants;
- Power;
- Data Storage; and
- Attitude Control System.

For any other driving mission element requirements derived from the Mission Functional Requirements, provide estimates of implementation performance and design margins with respect to the required performance.

Definitions:
Contingency when added to the current estimate for a resource, results in the maximum expected value for that resource. Percent contingency is the value of the contingency divided by the value of the resource less the contingency.
Margin is the difference between the maximum possible capability of a resource (the physical limit or the agreed-to limit) and the maximum expected value for a resource. Percent margin for a resource is the available margin divided by its maximum expected value.
Example: A payload in the design phase has a maximum expected mass of 115 kg including a mass contingency of 15 kg. There is no other payload on the ELV and the ELV provider plans to allot the payload the full capability of the vehicle, if needed. The ELV capability is 200 kg. The mass contingency is 15/100 = 15% and the mass margin is 85 kg or 85/115 = 74%.

Example: The end-of-life (EOL) capability of a spacecraft power system is 200 Watts, of which 75 Watts has be allocated to the instrument and 100 Watts has been allocated to the spacecraft bus. The power margin is the unallocated 25 Watts or 25/175 = 14.3%. The current best estimate for the instrument power is 60 Watts, leaving 15 Watts or 15/60 = 25% contingency to the 75 Watt maximum expected value.

Acknowledging that the maximum expected resource value is equal to the maximum proposed resource value (including contingency), the above technical terms can be expressed in equation form as:

Contingency = Max Expected Resource Value – current estimate of Resource Value

$$\% \text{ Contingency} = \frac{\text{Contingency}}{\text{Max Expected Resource Value} - \text{Contingency}} \times 100$$

Margin = Max Possible Resource Value – Max Expected Resource Value

$$\% \text{ Margin} = \frac{\text{Margin}}{\text{Max Expected Resource Value}} \times 100$$

Requirement B-35. Mission Operations: This section shall address, at a minimum, the following elements of mission operations to the extent that they are applicable to the proposed mission and that they are known at the time of proposal submission. Any additional elements that are applicable to explaining the mission operations and demonstrating their feasibility shall also be addressed. This section shall provide, at a minimum,

- Description of ground systems and facilities including supporting ground software required for development and testing;
- Telecommunications, Tracking, and Navigation (Deep-Space/Lunar and Earth Orbital missions, as well as missions that utilize telecom relay orbiters) including (i) downlink information data volume, (ii) uplink information, (iii) for all transmit and receive modes, provide mode timeline, data rate(s), and durations, and (iv) ground network utilization plan including ground stations, downlink frequencies/ periods/ capacities/ margins, etc., retransmission capability;
- Description of approach for acquiring and returning critical event data, including clear identification of procurement and costing for supplemental resources (*e.g.*, mobile ground stations) if such are needed;
- A high-level discussion of operations plan, including nominal sequence planning and commanding, team training, availability of spacecraft experts for operations, operations center development; and

3. Development Approach.

Requirement B-36. This section shall describe the development approach. This description shall include, at a minimum, the following items:

- Systems engineering approach (*e.g.*, plans, tools, processes for requirements, interfaces, and configuration management);
- Mission assurance approach, including (1) fault tolerance and fault management, (ii) product assurance, (iii) reliability (*e.g.*, use or non-use of redundancy, requirements for burn-in of parts, requirements for total operating time without failure prior to flight, *etc.*);
- Identification of instrument to spacecraft interfaces;
- Design maturity and heritage of mission elements (instruments, spacecraft, ground systems, and mission design, etc.) by reference to Appendix 10, Heritage, of the proposal (see Section J of this appendix);
- Essential trade studies that are to be conducted;
- Approach to management and closure of action items, hardware discrepancies, test anomalies, etc.; and
- Approach for handling special processes (*e.g.*, if radioactive sources are proposed, the approach to supporting the development, submittal, and approval of the necessary NEPA process and the Nuclear Safety Launch Approval process).

4. New Technologies/Advanced Developments.

Requirement B-37. This section shall describe any proposed new technologies and/or advanced developments and the approaches that will be taken to reduce their associated risks. If no advanced development is required, the justification for TRL 6 or above shall be clearly demonstrated. These descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed new development and/or advanced development at the time the proposal is submitted (for *TRL definitions*, see NPR 7120.8, *NASA Research and Technology Program and Project Management Requirements*, Appendix J, in the Program Library);
- Rationale for combining the TRL values of subsystems to derive the full system TRL as proposed;
- Rationale for the stated TRL value of a system that is an adaptation of an existing system of known TRL;
- The proposed approach for maturing each of the identified items to a minimum of TRL 6, defined as "system/subsystem model or prototype demonstration in a relevant environment, space, or ground" by the end of Phase B (include discussion of simulations, prototyping, systems testing, life testing, etc., as appropriate);
- An estimate of the resources (manpower, cost, and schedule) required to complete the technology development; and
- Approaches to fallbacks/alternatives that exist and are planned, a description of the cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance liens they impose on the baseline design, and the decision milestones for their implementation.

5. Assembly, Integration, Test, and Verification.

Requirement B-38. An illustration and brief discussion of the time-phased flow of the Integration and Test (I&T) Plan shall be presented. It shall summarize the key facilities, testbeds, and team members involved in the I&T Plan.

Requirement B-39. The project's verification approach shall be described briefly in this section. Flow diagrams, narrative text, and/or other relevant data may be used to convey this information. Elements of the approach that pose special challenges for the project (*e.g.,* mission critical performance or functional requirements that can't be tested on the ground, special facilities that may be required for testing, large scale simulation tools that must be developed and how they will be validated, critical path items, etc.) shall be highlighted. The T&V description shall demonstrate the credibility of the overall T&V approach as reflected by consistency between the described test plans and the schedule, cost, and other resources needed to carry them out.

6. Schedule.

Requirement B-40. A project schedule foldout covering all phases of the investigation shall be provided. This foldout will not be counted against the page limits. The schedule format shall have a timeline granularity of months or finer, have a corresponding table of dates, and follow standard NASA WBS elements for task descriptions as prescribed in NPR 7120.5D. The schedule foldout and accompanying narrative shall address proposed major milestones including, at a minimum, the following items:

- Spacecraft development and major review dates;
- Instrument development and major review dates including instrument-to-spacecraft/host integration and test;
- Ground systems development and major review dates (*e.g.,* mission operations and data analysis development schedule);
- Major deliverables (*e.g.,* ICDs, simulators, engineering modules, flight modules, *etc.*);
- Launch vehicle integration and launch readiness;
- Long-lead item specifications, development paths, and their impacts to schedule;
- Development schedule for SEOs, if any;
- Schedule critical path identification; and
- Funded schedule reserve, with indications of appropriate reserves associated with major milestones and deliverables.

G. MANAGEMENT

The following expands requirements in the AO, in particular Requirement 23, Requirement 34 through Requirement 41, Requirement 57, and Requirement 71.

Requirement B-41. This section shall describe the investigator's proposed management approach. The management organization (including an organization chart) and decision-

making process shall be described, and the teaming arrangement and team communications shall be discussed. The organization chart should clearly indicate how the mission team is structured. The names of the primary team members, their organization, and their reporting relationship in the program shall be provided..

Requirement B-42. This section shall describe the specific roles and responsibilities of the PI, PM, and other named key management team members. It shall describe the qualifications and experience, especially any previous experience with similar systems and/or equipment (including their performance in meeting cost and schedule), of these key management team members, and demonstrate that they are commensurate with the technical and managerial needs of the proposed investigation. It shall also describe the qualifications and experience of the primary implementing institutions and demonstrate that they are commensurate with the technical and managerial needs of the proposed investigation.

Requirement B-43. This section shall describe the top risks considered significant by the PI and the PM, especially technical risks and risks associated with contributed hardware (if any), and potential mitigation strategies and associated schedule impacts. If cost risks are in this list, they should be described here and then discussed in Section H (see Requirement B-48). The management strategies for control, allocation, and release of technical margins, cost reserves, and schedule reserves shall be described. The approach to any potential descopes, including savings of resources (mass, power, dollars, schedule, etc.) by implementing descopes, and the decision milestone(s) for implementing descopes shall be discussed. Specifically, this description shall identify how these margins and reserves are to be allocated, tracked, and monitored, with what tools and by whom, and who will have the authority to release them. When contracts are required, the acquisition strategy including any incentive strategy shall be described.

Requirement B-44. If the proposal contains proposed contributions or cooperative arrangements, this section shall describe the technical and management interfaces in any proposed cooperative arrangements, explicitly demonstrating that the contributions are within the contributors' scientific and technical capabilities, and contingency plans for coping with potential failures of the proposed cooperative arrangements.

Requirement B-45. In the case where a proposal does not provide the required management and schedule details, for whatever reason, this section shall (i) describe the current management approach and schedule, (ii) justify that the development of that aspect of the project management and schedule is not required at this stage and that it is acceptable to develop details later, and (iii) explain why the lack of information at this stage should not translate into a risk to the proposer's ability to implement the mission as proposed, and (iv) justify the adequacy of the proposed cost reserves, given that the proposed cost is not allowed to increase beyond the cost cap during Phase A or at any later time. The process for developing the required depth of information, along with a corresponding schedule, shall be explicitly included among the plans for future activity.

H. COST AND COST ESTIMATING METHODOLOGY

The following expands requirements in the AO, in particular Requirement 53 through Requirement 56 and Requirement 58 through Requirement 67.

This section of the proposal must include an estimated cost of the investigation, a description of the methodologies used to develop the estimate, and a discussion of cost risks.

Requirement B-46. This section shall include the estimated cost of the proposed investigation. The estimated cost shall encompass all proposed activities, including all applicable mission phases, mission unique or special launch services, flight systems, ground systems, ground network fees, contributions, core E/PO program, any other AO-specific activities (*e.g.,* SC), and all cost reserves. These costs shall be consistent with the policies and requirements described in Section 4 and 5 of this AO.

Requirement B-47. This section shall include a description of the methodologies used to develop the estimate. The cost estimating methodology discussion in this section shall provide an overview of the cost estimate development process. Any additional cost estimates or other validation efforts shall be described, the results presented, and any significant discrepancies discussed. The rationale for the proposed cost reserve levels shall be presented. Proposers shall provide additional Basis of Estimate data to assist the validation of their costs estimates. Examples of useful Basis of Estimate data include cost comparisons to analogous items/missions, vendor quotes, and parametric model results.

Requirement B-48. This section shall include a discussion of cost risks.

Requirement B-49. This section shall provide a foldout cost table, Table B3, which will not be counted against the page limit. Table B3 shall identify the proposed cost required in each mission phase and in each fiscal year; the costs shall be in real year dollars (RY$). The top portion of Table B3 shall contain cost data relevant to the PI-managed Mission Cost. The lower portion shall contain cost data for contributions and enhanced mission costs. The rows in Table B3 shall be the NASA standard WBS elements as defined in NPR 7120.5D. The costs for most elements shall be provided to WBS level 2, as shown in Table B3. Exceptions are the costs of individual instruments and any unique flight system elements such as landers or sample return capsules, which shall be explicitly shown. The columns in Table B3 shall be grouped and subtotaled by mission phase and shall be labeled with the appropriate fiscal years fiscal years which span more than one mission phase shall be split into two columns by mission phase. The final two columns are totals in real year dollars (RY$) and totals in fiscal year <<YEAR>> dollars (FY00$). Proposers shall use their own forward pricing rates to translate between real year dollars (RY$) and fiscal year <<YEAR>> dollars (FY00$). For organizations that are without approved forward pricing rates, proposers may use the NASA inflation/deflation indices in Table B4 to translate between real year dollars (RY$) and fiscal year <<YEAR>> dollars (FY00$).

Requirement B-50. Table B3 shall be provided additionally in EXCEL format on each CD submitted with the proposal.

Requirement B-51. This section shall include a statement as to whether the proposer's approved forward pricing rates were used or NASA's inflation/deflation indices were used. If the proposer's approved forward pricing rates were used, this section shall include an explanation for how the forward pricing rates were derived to translate between real year dollars (RY$) and fiscal year <<YEAR>> dollars (FY00$) in Table B3.

I. SMALL BUSINESS SUBCONTRACTING PLAN, ACKNOWLEDGEMENT OF EDUCATION AND PUBLIC OUTREACH, AND OPTIONAL STUDENT COLLABORATION

The following expands requirements in the AO, in particular Requirement 47 through Requirement 52.

1. Small Business Subcontracting Plan

Requirement B-52. This section shall include one of the following, as applicable: (i) demonstration that the offeror is a small business concern, (ii) demonstration that subcontracting opportunities are not reasonably available in the performance of the Phase A concept study, or (iii) small business subcontracting plans meeting the requirements in Section 5.5.1, Appendix A, and referenced parts of the FAR.

2. Education and Public Outreach

Requirement B-53. This section shall include the required statement of commitment from the PI (see Section 5.5.2 of this AO).

3. Student Collaboration

Requirement B-54. If a Student Collaboration (SC) as described in Section 5.5.3 of this AO is proposed, then this section shall provide details of the development schedule of the SC, including decision points for determining SC readiness for flight. This section shall describe how the SC can be incorporated into the mission on a nonimpact basis. This section shall show that the SC is clearly separable from the rest of the proposed effort.

J. APPENDICES

Requirement B-55. The following additional information is required to be supplied with the proposal as Appendices and, as such, will not be counted within the specified page limit. No other appendices are permitted.

1. Table of Proposal Participants

The following expands requirements in the AO, in particular Requirement 77.

Requirement B-56. A table of proposal participants shall be provided. The table shall include all organizations named in the proposal. The primary purpose of the table is to aid NASA in avoiding conflicts of interest during the evaluation of the proposal. A secondary purpose is to provide material helpful for the evaluation and selection process. The table shall have three columns: (i) name of organization including city and state/country where it is located, (ii) role of organization, and (iii) total cost or budget for that organization (real year dollars over the life of proposal for baseline mission). The table shall have a row for every organization named in the proposal, and the rows shall be organized into three sections: (i) major partners, (ii) science only, nonhardware partners, and (iii) minor partners, vendors, and suppliers as known at the time of the proposal. Major partners are defined to be organizations responsible for providing project management, system engineering, major hardware elements, science instruments, integration and test, mission operations, and other major elements of the proposed investigation as defined by the proposer.

2. Letters of Commitment.

The following expands requirements in the AO, in particular Requirement 30, Requirement 70, Requirement 76, and Requirement 77.

Requirement B-57. Letters of commitment signed by an institutional official shall be provided from (i) all organizations offering contributions of goods and/or services (both U.S. and non-U.S. but excluding Co-I services) on a no-exchange-of-funds basis including all non-U.S. organizations providing hardware or software to the investigation, and, (ii) unless otherwise explicitly excepted elsewhere in this AO, all major participants in the proposal regardless of source of funding. Major partners are the organizations in section (i) of the Table of Proposal Participants. Requirements for letters of commitment may be found in Section 5.8.1 of this AO.

3. Resumes.

The following expands requirements in the AO, in particular Requirement 34, Requirement 35, Requirement 43, and Requirement 44.

Requirement B-58. This section shall include resumes or curriculum vitae for the PI, PM, all Co-Is identified in the science section, and for any key project personnel who are named in the proposal. Specifically, each resume shall cite the individual's experience that is pertinent to the role and responsibilities that she/he will assume in the proposed investigation. Project management experience shall be included in the resumes of the PI, PM, and Project SE (if named). Resumes or curriculum vitae shall be no longer than three pages for the PI and one page for each additional participant. Resumes shall be organized alphabetically, by surname after that of the PI.

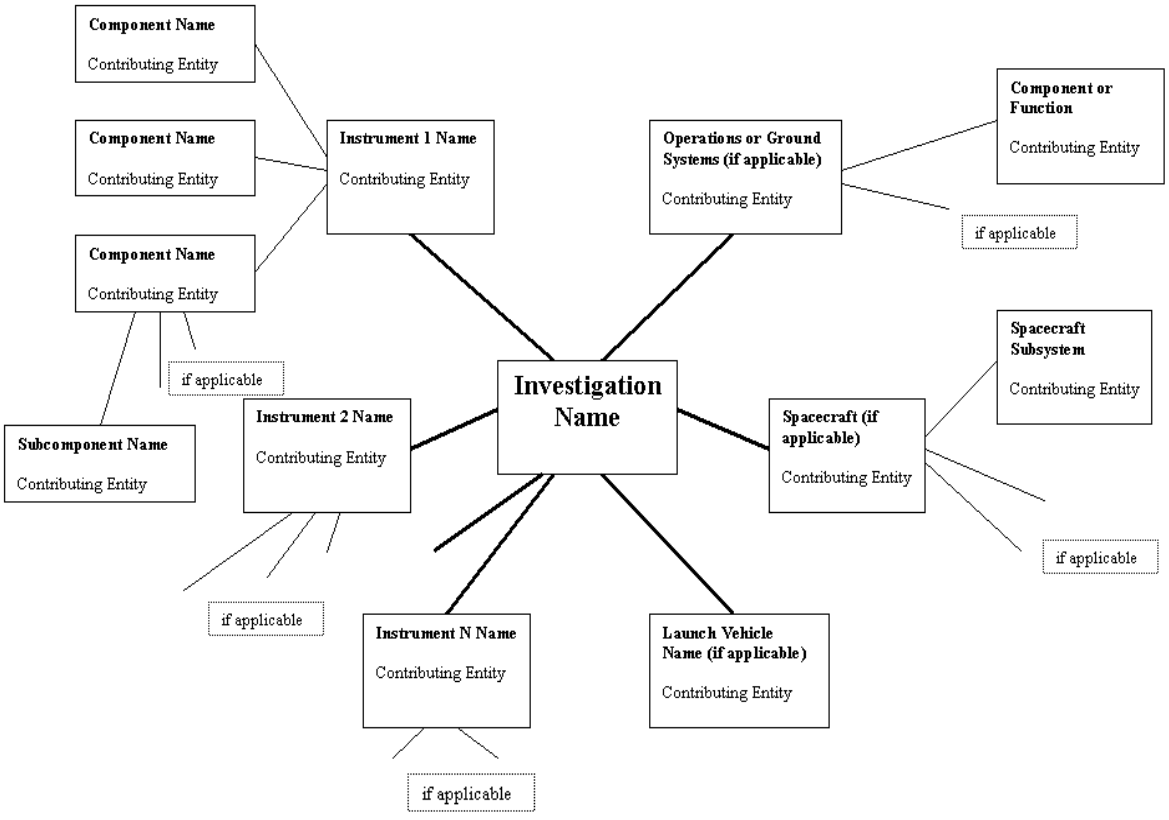
4. Summary of Proposed Program Cooperative Contributions.

The following expands requirements in the AO, in particular Requirement 66 through Requirement 68 and Requirement 73.

Cooperative contributions are defined to be those that are to be provided to the proposed investigation from a U.S. or non-U.S. partner on a no-exchange-of-funds basis. In order to aid NASA in conducting an equitable assessment of risks, this section shall include (a) an "exploded diagram" of the investigation and (b) a supporting table.

a. An "exploded diagram" of the investigation.

SAMPLE EXPLODED DIAGRAM



Requirement B-59. If a proposal includes cooperative contributions, this section shall include an "exploded diagram" of the investigation (see example figure) that provides a clear visual representation of cooperative contributions incorporated in the proposed implementation approach. All cooperative contributions, including those that will require an international agreement or interagency memorandum of agreement, shall be shown in

this diagram. Each contribution shown shall display a unique name for the contribution, as well as the identity of the contributing entity. However, the following should not be shown:

i. If there are no cooperative contributions of spacecraft, launch vehicle or services, or ground operations or facilities, these boxes should not be shown on the diagram at all.
ii. Scientific collaborations such as joint data analysis that do not involve contribution of flight hardware or other critical items should not be shown.
iii. U.S. or non-U.S. goods and services obtained by contract using NASA funds are not cooperative contributions and are also not to be shown.

b. A supporting table of collaborative contributions

Requirement B-60. If a proposal includes cooperative contributions, this section shall include a supporting table with more information that elaborates upon each cooperative contribution shown in the exploded diagram. The table shall include, for each contribution, the following information:

i. Unique name identifying the contribution (matching the name on the exploded diagram);
ii. The identity of the providing organization, whether U.S. or non-U.S.;
iii. The roles and responsibilities of the providing organization, including cross reference to information in the proposal providing further detail as required in Section 5.6.7 of this AO;
iv. The identification of the funding sponsor if different from the organization identified in item (ii) above;
v. The approximate value of the contribution, in U.S. dollars as defined in Section 5.6.7 of this AO; and
vi. Cross reference to letters of commitment as required in Section 5.8.1 of this AO.

5. Draft International Participation Plan - Discussion on Compliance with U.S. Export Laws and Regulations.

The following expands requirements in the AO, in particular Requirement 75.

Requirement B-61. If a proposal includes international participation, either through involvement of non-U.S. nationals and/or involvement of non-U.S. entities, this section shall discuss compliance with U.S. export laws and regulations; *e.g.*, 22 CFR 120-130, *et seq*. and 15 CFR 730-774, *et seq*., as applicable to the scenario surrounding the particular international participation. The discussion shall describe in detail the proposed international participation and is to include, but not be limited to, whether or not the international participation may require the proposer to obtain the prior approval of the Department of State or the Department of Commerce via a technical assistance agreement or an export license, or whether a license exemption/exception may apply. If prior approvals via licenses are necessary, discuss whether the license has been applied for or, if not, the projected timing of the application and any implications for the schedule. Information regarding U.S. export regulations is available at http://www.pmddtc.state.gov/ and http://www.bis.doc.gov/. Proposers are advised that

under U.S. law and regulation, spacecraft and their specifically designed, modified, or configured systems, components, parts, etc., such as instrumentation responsive to this AO, are generally considered "Defense Articles" on the United States Munitions List and subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR 120-130, *et seq*.

Requirement B-62. Foreign nationals requiring access to NASA facilities and information systems will be required to comply with Homeland Security Presidential Directive HSPD-12 (see http://hspd12.nasa.gov/), where applicable. This appendix shall also discuss the impact, if any, on the investigation and the proposed international participation of compliance with HSPD-12. If no impact is anticipated, this shall be explicitly stated.

6. (AO OPTION) Planetary Protection and/or Sample Curation Plan.

6a. Planetary Protection Plan

The following expands requirements in the AO, in particular Requirement 10 and Requirement 11.

Requirement B-63. If applicable, this section shall describe the plan for compliance with the planetary protection requirements described in Section 5.1.5.1 of this AO. At a minimum, it shall address (i) the anticipated planetary protection Category of the mission under NASA directives; (ii) the proposed mission operational accommodations to comply with the anticipated requirements, including organizational responsibilities; and (iii) the proposed steps to be taken for the preparation of orbital and/or landed portions of the spacecraft to comply with any requirements for overall microbiological cleanliness and recontamination prevention prior to launch. If describing a sample return mission, this appendix shall additionally address (iv) the nature of the proposed implementation of back-contamination control and subsequent containment and testing of returned samples, or the proposed rationale for the mission to be relieved from a containment requirement. This appendix shall address steps intended to be taken for planetary protection compliance and the implementing organization(s) responsible for implementing those steps.

6b. Sample Curation Plan

The following expands requirements in the AO, in particular Requirement 12 and Requirement 13.

Requirement B-64. If applicable, this section shall describe the plan for sample curation at the NASA JSC Astromaterials Curatorial Facility in accordance with the requirements in Section 5.1.5.2. At a minimum, this plan shall describe (i) the nature of samples expected to be returned, (ii) the methods used to prevent sample contamination or degradation during collection and return to Earth, (iii) the environmental conditions of the sample curatorial facility, (iv) the general procedures for storage, subsampling,

documentation, distribution, and security, (v) the preliminary examination of the samples, and (vi) the preparation (within 6 months of return) of a sample catalog sufficient for other scientists to request samples. The plan shall demonstrate that at least 75% of the returned sample shall be preserved for future studies.

7. (AO OPTION) Discussion of End of Mission Spacecraft Disposal Requirements.

The following expands requirements in the AO, in particular Requirement 32.

This appendix is required only for proposed missions to Low Earth Orbit (LEO) (<2000 km perigee), near Geosynchronous orbit (GEO) (GEO ± 300 km), or the Moon (orbiters and landers).

Requirement B-65. For LEO missions, this section shall briefly discuss the lifetime of the mission and whether it meets the 25-year post-mission (or 30-year from launch – whichever comes first) requirement for LEO missions or, alternatively, how the mission meets the orbit disposal requirement applicable for its proposed orbit.

This section shall include a mission lifetime analysis demonstrating satisfaction of the above requirement, addressing all assumptions and inputs contributing to the analysis. These assumptions and inputs shall include, at a minimum:

- Vehicle Mass
- Drag Area or Cross-sectional Area
- Initial orbit used for the analysis
- Solar and atmospheric conditions assumptions (*i.e*., models or parameters)
- Methodology: analytical tool, table lookup, reference plot.

If the plan is to dispose of the satellite at the end of mission, this section shall provide the parameters of the disposal orbit, the delta-v allocation for disposal, and any other relevant assumptions.

Requirement B-66. For Lunar missions, this section shall include a discussion of how end-of-mission requirements will be met.

The following references are available in the Program Library:

- NPR 8715.6, *NASA Procedural Requirements for Limiting Orbital Debris*; and
- NASA-STD-8719.14, *NASA Process for Limiting Orbital Debris.*

8. Compliance with Procurement Regulations by NASA PI Proposals.

The following expands requirements in the AO, in particular Requirement 42.

This appendix is required only for proposals submitted by NASA PIs or NASA Centers (excluding JPL). Proposals submitted by NASA Centers must comply with regulations governing proposals submitted by NASA PIs (NFS 1872.308). Additional instructions may

be found in Procurement Information Circular (PIC) 05-15 at http://www.hq.nasa.gov/office/procurement/regs/pic.html.

Requirement B-67. For NASA Center proposals, this section shall include any descriptions, justifications, representations, indications, statements, and/or explanations that are required by the regulations.

9. Master Equipment List.

The following expands requirements in the AO, in particular Requirement 62.

Requirement B-68. This section shall include a Master Equipment List (MEL) summarizing all flight element subsystem components and individual instrument element components to support validation of proposed mass estimates, design heritage, and cost. A template for this MEL is included as Table B5.

Requirement B-69. The MEL shall be additionally provided in EXCEL format on each CD submitted with the proposal.

For each component, current best estimates (CBE) and contingency for mass and power, number of flight units required, and some description of the heritage basis must be provided. Power values should represent nominal steady-state operational power requirements. Information to be provided includes identification of planned spares and prototypes, required deliveries for simulators and testing, contingency allocations for individual components, and other component description/characteristics. Certain items (like electronic boxes and solar arrays) should include additional details, as applicable, to identify and separate individual elements.

10. Heritage.

The following expands requirements in the AO, in particular Requirement 58.

Requirement B-70. This section shall discuss each element of any heritage from which the proposed investigation derives substantial benefit, including heritage from spacecraft subsystems, instruments, ground systems, flight and ground software, test set ups, simulations, analyses, etc. This discussion shall be at an appropriate level of granularity (*e.g.*, component, assembly, subsystem) to clearly separate the heritage element from other elements of the design. The discussion of each element shall include:

- a concise description of the design heritage claimed;
- the anticipated benefits to the proposed investigation;
- a brief rationale supporting the claim that the benefits of heritage will be achieved; and
- for any proposed elements with substantial design heritage, a comparison of the cost of the heritage items to the proposed cost.

Proposals must substantiate all heritage claims, including descriptions of changes required to accommodate project-unique applications and needs. Where enhancements to heritage elements are proposed or heritage is from a different application, sufficient descriptions must be provided to independently assess the current level of maturity.

The evaluation team will use a scale with at least three levels (full, partial, or none) as illustrated in the table below.

	Full heritage	**Partial heritage**	**No heritage**
Design	Identical	Minimal modifications	Major modifications
Manufacture	Identical	Limited update of parts and processes necessary	Many updates of parts or processes necessary
Software	Identical	Identical functionality with limited update of software modules (<50%)	Major modifications (>=50%)
Provider	Identical provider and development team	Different however with substantial involvement of original team	Different and minimal or no involvement of original team
Use	Identical	Same interfaces and similar use within a novel overall context	Significantly different from original
Operating Environment	Identical	Within margins of original	Significantly different from original
Referenced Prior Use	In operation	Built and successfully ground tested	Not yet successfully ground tested

11. List of Abbreviations and Acronyms.

The following expands requirements in the AO, in particular Requirement 85.

Requirement B-71. This section shall provide a list of abbreviations and acronyms.

12. List of References (optional).

In addition to the above items, this section may provide a reference list of documents and other materials that were fundamentally important in generating the proposal. This may include a Uniform Resource Locator (URL) for documents that are available through the Internet. As noted at the outset of Appendix B of this AO, however, proposals must be self-contained: any data or other information intended as part of a proposal must be included within the proposal itself. If any documents or other materials are submitted as a part of a proposal, they must fit within the prescribed page limits.

TABLE B1
EXAMPLE SCIENCE TRACEABILITY MATRIX

Science Goals	Science Objectives	Scientific Measurement Requirements		Instrument Functional Requirements		Projected Performance	Mission Functional Requirements (Top Level)
		Observables	Physical parameters				
Goal 1		Absorption line	Column density of absorber				Observing strategies: requires yaw and elevation maneuvers
Goal 2		Emission line	Density and temperature of emitter	Alt. Range	XX km	ZZ km	Launch window: to meet nadir and limb overlap requirement. Window applies day to day
Etc.	Objective 1		Size of features	Vert. Resol.	XX km	ZZ km	Need AA seasons to trace evolution of phenomena
		Morphological feature		Horiz. Resol.	XX deg x XX lat x XX long	ZZ deg x ZZ lat x ZZ long	
			Rise time of eruptive phenomenon	Temp. Resol.	XX min	ZZ min.	Need AA months of observation to observe variability of phenomena
				Precision	XX K	ZZ K	
		Rate of change of observable phenomenon		Accuracy	XX K	ZZ K	
	Objective 2 to N			Repeat above categories			

TABLE B2
EXAMPLE MISSION TRACEABILITY MATRIX

Mission Functional Requirements	Mission Design Requirements	Spacecraft Requirements	Ground System Requirements	Operations Requirements
From Table B1	Rocket type Launch date: Mission length Orbit altitude requirement and rationale Geographic coverage and how it drives orbit requirement Orbit local time and rationale for the requirement Type of orbit, e.g. Sun synchronous, precessing, Lagrangian point, other Other	Spinning, stabilized Mass Power Volume: Data Rate Temperature Range for spacecraft systems Pointing Control: Knowledge, Stability, Jitter, Drift , Other Detector radiation shielding requirements and rationale Other	Passes per day and duration Assumed antenna size Data volume per day Real time data transmission requirements Transmit frequency Power available for comm (Watts) Downlink data rate Number of data dumps per day Spacecraft data destination (e.g., mission operations center) Science data destination (e.g., science operations center) Other	General spacecraft maneuver requirements and frequency Special maneuvers requirements Rationale for maneuvers Ephemeris requirements Changes in viewing modes and directions per orbit, per day or over longer time periods. Rationale for these changes Other
Msn Functional Req or Instrument Accommodation (from Table B1)	Mission	Spacecraft	Ground System	Operations
Four different observing strategies: Solar, limb, nadir, zenith; requires yaw and elevation maneuvers		Agility requirements Slew rate = y deg/sec Settle = stability < .001 deg/sec after 30 secs		Target planning on 3 day centers Ephemeris accuracy of x with updates every 2 days
Instrument X precision of 5K		Thermal stability of 1 deg/hr S/C bus stability of .01 deg over 10 secs	Bit error rate < 1e-5 Time correlation to 2 msec over 1 week	Weekly time correlation

TABLE B3
TOTAL MISSION COST FUNDING PROFILE TEMPLATE

Total Mission Cost Funding Profile Template

FY costs in Real Year Dollars (RY$), Totals in Real Year Dollars (RY$) and Fiscal Year 2008 Dollars (FY08$)

WBS#	WBS Element	Phase A			Phase B			Phase C/D			Phase E			RY$	FY08$
		FY20XX	FY20XX+1	Total	FY20XX+1	FY20XX+2	Total	FY20XX+2	FY20XX+3	FY20XX+4	FY20XX+4	FY20XX+5	FY20XX+6	Total	Total
01	Project Management														
02	Systems Engineering														
03	Safety & Mission Assurance														
04	Science / Technology														
05	Payload(s)														
	List each instrument separately														
06	Spacecraft														
	List each major flight system element separately														
07	Mission Operations														
08	Launch Vehicle / Services														
09	Ground System(s)														
10	Systems Integration & Testing														
11	Education and Public Outreach														
	Reserves														
	PI-Managed Mission Cost														
Contributions															
	List by organization and WBS element														
	Total Contributions														
	Total Mission Cost														
Other AO-specific Activities															
	List by activity and WBS element														
	Enhanced PI-Managed Mission Cost														
	Phase B Bridge Phase Funding (*included above*)														

Label columns with actual fiscal years. Add or remove FY columns as necessary.

An EXCEL version of this template is available in the Program Library.

TABLE B4
NASA NEW START INFLATION INDEX

Fiscal Year	2008	2009	2010	2011	2012	2013	2014	2015
Inflation Rate	0.0%	2.7%	2.7%	2.9%	3.0%	2.8%	2.7%	2.7%
Cumulative Inflation Index	1.0	1.027	1.055	1.085	1.117	1.149	1.181	1.212

Use an inflation rate of 2.7% for years beyond 2015.

Note: Proposers shall use their own forward pricing rates. For organizations that are without forward pricing rates, proposers may use the NASA new start inflation index in Table B4 to convert between real year dollars (RY$) and fiscal year <<YEAR>> dollars (FYXX$) (see Appendix B, Section H).

TABLE B5
MASTER EQUIPMENT LIST

S/C Element 1		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Subsystem/Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contin-gency %	Total Mass w/ Contin-gency	Total Power, W CBE	Contin-gency %	Total Power w/ Contin-gency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component specific information)
Total Mass/Power												

S/C Element *n*		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Subsystem/Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contin-gency %	Total Mass w/ Contin-gency	Total Power, W CBE	Contin-gency %	Total Power w/ Contin-gency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component specific information)
Total Mass/Power												

Payload Element 1		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Subsystem/Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contin-gency %	Total Mass w/ Contin-gency	Total Power, W CBE	Contin-gency %	Total Power w/ Contin-gency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component specific information)
Total Mass/Power												

Payload Element *n*		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Subsystem/Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contin-gency %	Total Mass w/ Contin-gency	Total Power, W CBE	Contin-gency %	Total Power w/ Contin-gency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component specific information)
Total Mass/Power												

An EXCEL version of this template is available in the Program Library.

APPENDIX C

GLOSSARY OF TERMS AND ABBREVIATIONS

Part C.1: GLOSSARY OF TERMS

Announcement of Opportunity (AO) — A document used to announce opportunities to participate in NASA programs.

AO Process — A term used to describe the program planning and acquisition procedure used to acquire investigations through an AO.

AO Steering Committee — A NASA committee composed wholly of full-time Federal Government employees that provides advice to the Mission Directorate Associate Administrator and provides procedural review over the investigation evaluation, categorization, and selection process.

Backward contamination — The transmittal to Earth from another body of viable organisms by a spacecraft or spacecraft component.

Baseline science mission — The mission that, if fully implemented, would accomplish the entire set of scientific objectives proposed for the investigation.

Baseline science objectives — The entire set of scientific objectives proposed for the investigation.

Basis of Estimate (BOE) — A record of the procedures, ground rules and assumptions, data, environment, and events that underlie a cost estimate's development or update. Good documentation of the BOE supports the cost estimate's credibility.

Categorization — The process whereby proposed investigations are classified into four categories synopsized here as Category I (recommended for immediate acceptance); Category II (recommended for acceptance but at a lower priority than Category I proposals); Category III (sound investigations requiring further development); Category IV (not recommended).

Categorization Subcommittee — An ad hoc subcommittee of the AO Steering Committee, composed wholly of Civil Servants and Intergovernmental Personnel Act appointees (some of whom may be from Government agencies other than NASA) and appointed by the Associate Administrator for the Science Mission Directorate, that categorizes proposals for investigations submitted in response to an AO based on the evaluations.

Co-Investigator (Co-I) — An investigator who plays a necessary role in the proposed investigation and whose services are either funded by NASA or are contributed by his/her employer. A NASA employee can participate as a Co-I on an investigation proposed by a private organization.

Collaborator — An individual who is less critical to the successful development of the mission than a Co-I. A collaborator may not be funded through the proposal. A collaborator may be committed to provide a focused contribution to the project for a specific task such as data analysis. If funding support is requested in the proposal for an individual, that individual shall not be identified as a collaborator but shall be identified as a Co-Investigator or another category of team member.

Complete spaceflight mission — A science investigation requiring an Earth-orbiting, near-Earth, or deep-space mission, that encompasses all appropriate mission phases from project initiation (Phase A) through mission operations (Phase E) and spacecraft disposal (Phase F), including the analysis and publication of data in the peer reviewed scientific literature, delivery of the data to an appropriate NASA data archive, and, if applicable, extended mission operations or other science enhancements.

Contingency — That quantity, when added to a resource, results in the maximum expected value for that resource.

Contribution — Labor, services, or hardware funded by any source other than Program sponsoring the AO.

Descope — Any alteration of a mission that renders it unable to accomplish one or more of the Baseline Science Mission scientific objectives.

Earned Value Management (EVM) — A tool for measuring and assessing project performance through the integration of technical scope with schedule and cost objectives during the execution of the project. EVM provides quantification of technical progress, enabling management to gain insight into project status and project completion costs and schedules.

Federal Acquisition Regulation (FAR) — The regulations governing the conduct of acquisition.

Forward contamination — The transmittal from Earth to a targeted solar system body of viable organisms by a spacecraft or spacecraft component.

Guest Investigators — Investigators selected to conduct observations and obtain data within the capability of a NASA mission, which are additional to the mission's primary objectives. Sometimes referred to as Guest Observers or General Observers.

Implementing organization — The organization chosen by the Principal Investigator to manage the development of the mission.

Investigation — Activities or effort aimed at the generation of new knowledge. NASA-sponsored investigations generally concern the generation and analysis of data obtained through measurement of space phenomena or earth phenomena using spaceflight hardware developed and operated for that purpose.

Investigation Team — The group of scientists, engineers and other professionals implementing an investigation.

Key Management Team Members **—** The project leaders whose qualifications and experience are relevant and necessary to the success of the project. Key management team members are the PI, PM, PSE, and, where appropriate, PS and partner leads, and other roles as identified in the proposal.

Margin — The allowance carried on a resource (*e.g.*, budget, schedule, mass) to account for uncertainties and risks. It is the difference between the maximum possible capability of a resource (the physical limit or the agreed-to limit) and the maximum expected value for a resource.

Minimum science mission — The mission that would accomplish the minimum subset of Baseline Science Mission scientific objectives sufficient to justify the proposed cost of the mission.

Mission — Used interchangeably with investigation.

Mission Architecture — The summary level description of the over all approach to the mission in the context of achieving the science objectives including mission elements such as flight systems, instruments, high-level mission plan, high-level operations concept, etc.

NASA FAR Supplement — Acquisition regulations promulgated by NASA in addition to the FAR.

Notice of Intent — A notice or letter submitted by a potential investigator indicating the intent to submit a proposal in response to an AO.

Payload — A specific complement of instruments, space equipment, and support hardware carried to space to accomplish a mission or discrete activity in space.

Peer Review (n) — A gathering of experts in related disciplinary areas convened as a subcommittee of the AO Steering Committee to review proposals for flight investigations.

Peer Review (v) — The process of proposal review utilizing a group of peers in accordance with the review criteria as outlined in the Announcement of Opportunity.

Performance Metrics — A multi-party agreement between the Program Office, the PI institution, the project management institution, and other major partners that is used for project evaluation by NASA.

PI-Managed Mission Cost — The funding that the Program sponsoring the AO will be expected to provide to the PI's implementation team for the development and execution of the proposed project, Phases A through F. It includes any reserves applied to the development and operation of the mission as well. It also includes any costs that are required to be accounted for against the PI-Managed Mission Cost even though the PI is not responsible for those costs (*e.g.*, NASA-provided telecom and network). The PI-Managed Mission Cost is capped.

Principal Investigator (PI) — The person who conceives of an investigation and leads implementation of it. The PI is invested by NASA with primary responsibility for implementing and executing selected investigations. A NASA employee can participate as a PI only on a government-proposed investigation.

Program — An activity involving human resources, materials, funding, and scheduling necessary to achieve desired goals.

Project — Within a program, an undertaking with a scheduled beginning and ending, which normally involves the design, construction, and operation of one or more spacecraft and necessary ground support in order to accomplish a scientific or technical objective.

Project Manager (PM) — The individual responsible to the PI for overseeing the technical and programmatic implementation of the project. The PM works closely with the PI in order to ensure that the mission meets its objectives within the resources committed to the project.

Project Office — An office established to manage a project.

Reserve — Resource not allocated to any specific task but held by the project for unexpected needs.

Resiliency — The quality of a mission to gracefully degrade from the Baseline Science Mission to the Minimum Science Mission as technical, schedule, or budgetary problems occur.

Risk — The combination of the probability that a program or project will experience an undesired event and the consequences, impact, or severity of the undesired event, were it to occur. The undesired event may come from technical or programmatic sources (*e.g.*, a cost overrun, schedule slippage, safety mishap, health problem, malicious activities, environmental impact, failure to achieve a needed scientific or technological objective, or success criterion). Both the probability and consequences may have associated uncertainties.

Science Enhancement Option (SEO) — An activity, such as extended missions, guest investigator programs, general observer programs, participating scientist programs, interdisciplinary scientist programs, or archival data analysis programs that have the potential to broaden the scientific impact of investigations.

Selection Official — The NASA official designated to determine the source for award of a contract or grant.

Team — A group of investigators responsible for carrying out and reporting the results of an investigation or group of investigations.

Team Member — A participant in an investigation including the Principal Investigator, a Co-Investigator, or any member of an investigation team. Team members are identified by role on the proposal's Electronic Cover Page.

Termination review — A review established to determine whether remedial actions, including changes in management structure and/or key personnel, would better enable a project to operate within established cost, schedule, and/or technical constraints. If a termination review determines that no remedy is likely to improve matters, NASA may consider termination of the project.

Total Mission Cost — The PI-managed Mission Cost plus any additional costs that are contributed or provided in any way other than through the Program sponsoring the AO.

Unencumbered reserve — Unexpended reserves that are not being held for an identified, but not yet realized, risk.

Work Breakdown Structure (WBS) — A product-oriented hierarchical division of the hardware, software, services, and data required to produce a project's end product(s), structured according to the way the work will be performed, and reflective of the way in which program/project costs, schedule, technical and risk data are to be accumulated, summarized, and reported.

Part C.2: COST ELEMENT DEFINITIONS

This is a short dictionary of definitions for the cost elements shown in the tables and discussed in the body of this AO.

Education and Public Outreach — Includes all costs associated with developing and implementing the proposed investigation's programs for education and public outreach.

Instruments — Instrument costs include costs incurred to design, develop, and fabricate the individual scientific instruments or instrument systems through delivery of the instruments to the spacecraft for integration. Costs for instrument integration, assembly, and test are to be shown separately from instrument development. Costs incurred for integration of the instruments to the spacecraft are included in the Spacecraft Integration, Assembly and Test cost element (see below).

Launch Checkout and Orbital Operations — Launch checkout and orbital operations support costs are those involving prelaunch planning, launch site support, launch-vehicle integration (spacecraft portion), and the first 30 days of flight operations.

Launch Services — Launch vehicles and services are either procured and provided by NASA to launch spacecraft under fixed price contracts, or provided by the proposer. The launch service price includes procurement of the ELV, spacecraft-to-launch vehicle integration, placement of spacecraft into designated orbit, analysis, post-flight mission data evaluation, oversight of the launch service and coordination of mission-specific integration activities.

Mission Operations and Data Analysis (MO&DA) — This cost element refers only to Phase E (postlaunch) and has two major components: Mission Operations and Data Analysis. Mission operations comprises all activities required to plan and execute the science objectives, including spacecraft and instrument navigation, control, pointing, health monitoring, and calibration. Data analysis activities include collecting, processing, distributing and archiving the scientific data. MO&DA costs include postlaunch all costs for people, procedures, services, hardware and software to carry out these activities. It includes post-launch science team support costs. It does not include costs of any STEO activities.

NASA Center Costs (all categories) — Additional costs born by the science investigation for NASA Center participation. For example, there may be additional project management/systems engineering costs, above those incurred by the spacecraft prime contractor, which are due to NASA employee participation. These costs must be reported on a full-cost accounting basis.

Prelaunch Science Team Support — Includes all Phase B/C/D (prelaunch) support costs for the science team. (See MO&DA below for post-launch component.)

Prelaunch GDS/Mission Operations Services (MOS) Development — Includes costs associated with development and acquisition of the ground infrastructure used to transport and deliver the telemetry and other data to/from the Mission Operations Center and the Science Operations Center. (For more information, refer to *NASA's Mission Operations and Communications Services* document in the SALMON Reference Library.) Includes development of science data processing and analysis capability. Also includes prelaunch training of the command team, development and execution of operations simulations, sequence development, and flight control software. This element includes any mission-unique tracking network development costs.

Project Management/Mission Analysis/Systems Engineering — Project management costs include all efforts associated with project level planning and directing of prime and subcontractor efforts and interactions, as well as project-level functions such as quality control and product assurance. Mission Analysis includes preflight trajectory analysis and ephemeris development. Systems engineering is the project-level engineering required to ensure that all satellite subsystems and payloads function properly to achieve system goals and requirements. This cost element also includes the data/report generation activities required to produce internal and deliverable documentation.

Project-Unique Facilities — If the proposed science investigation requires construction or lease of any ground facilities, include here only the portion of costs to be borne by the proposed investigation, with description of the nature and extent of any cost-sharing arrangements assumed.

Reserves — In that NASA maintains no reserves for science investigations or missions, reserves must include those funds that are not allocated specifically to estimated resources, but are held against contingencies or underestimation of resources to mitigate the investigation risk. Reserves must be reported according to the proposed reserve management strategy. For example, if the reserve is divided into funds to be pre-allocated to the flight system and instrument payload, with another portion held at the science investigation level, specific dollar amounts to fund each must be identified.

SEO Activities — Options for enlarging the science/technology impact beyond the baseline investigation, such as extended missions, guest investigator programs, general observer programs, or archival data analysis programs are termed SEO activities. These costs do not count against the funding cap.

Spacecraft Bus — Spacecraft bus costs include costs incurred to design, develop, and fabricate (or procure) the spacecraft subsystems. Costs for integration and assembly are not included in this element. Component level test and burn-in is included in this cost element. System tests are included in Spacecraft IAT (see below).

Spacecraft Integration, Assembly, and Test (IAT) — Spacecraft integration, assembly and test is the process of integrating all spacecraft subsystems and payloads into a fully tested, operational satellite system. The total cost of IAT for a satellite includes research/requirements specification, design and scheduling analysis of IAT procedures, ground support equipment, systems test and evaluation, and test data analyses. Typical satellite system tests include thermal vacuum, thermal cycle, electrical and mechanical functional, acoustic, vibration, electromagnetic compatibility/interference, and pyroshock.

Tracking Services including DSN — This line item includes all costs associated with this service for the specific proposed mission profile. (Refer to *NASA' s Mission Operations and Communications Services* document, in the Reference Library.)

Part C.3: ABBREVIATIONS AND ACRONYMS

AA	Associate Administrator
AO	Announcement of Opportunity
AOR	Authorized Organizational Representative
ASRG	Advanced Stirling Radioisotope Generator
CADRe	Cost Analysis Data Requirement
CCR	Central Contractor Registry
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CM&O	Center Management and Operations
Co-I	Co-Investigator
DOE	Department of Energy
DSN	Deep Space Network
EAR	Export Administration Regulations
E/PO	Education and Public Outreach
EBPOC	Electronic Business Point of Contact
EIS	Environmental Impact Statement
ELV	Expendable Launch Vehicle
EVM	Earned Value Management
FAQ	Frequently Asked Questions
FAR	Federal Acquisition Regulations
FASAB	Federal Accounting Standards Advisory Board
FFRDC	Federally Funded Research and Development Center
FONSI	Finding of No Significant Impact
FY	Fiscal Year
G&A	General and Administrative
GAO	Government Accountability Office
GDS	Ground Data System
GEO	Geosynchronous Orbit
GFE	Government Furnished Equipment
GFS	Government Furnished Service
HBCU	Historically Black Colleges and Universities
HBZ	HUB Business Zone
IAT	Integration, Assembly, and Test
ICD	Interface Control Document
IRD	Interface Requirements Document
ITA	Independent Technical Authority
ITAR	International Traffic in Arms Regulations
IV&V	Independent Verification and Validation
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
KDP	Key Decision Point
MEL	Master Equipment List
MMRTG	Multiple Mission Radioisotope Thermoelectric Generator
MO&DA	Mission Operations and Data Analysis

MOS	Mission Operations Services
MOU	Memorandum of Understanding
NAICS	North American Industry Classification System
NASA	National Aeronautics and Space Administration
NASA-STD	NASA-Standard
NEN	Near-Earth Network
NEPA	National Environmental Policy Act
NFS	NASA FAR Supplement
NISN	NASA Integrated Services Network
NLSA	Nuclear Launch Safety Approval
NODIS	NASA Online Directives Information System
NOI	Notice of Intent
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
NRA	NASA Research Announcement
NRC	National Research Council
NSPIRES	NASA Solicitation and Proposal Integrated Review and Evaluation System
NSS	NASA Safety Standard
OMI	Other Minority Institution
PDF	Portable Data Format
PDR	Preliminary Design Review
PI	Principal Investigator
PIC	Procurement Information Circular
P.L.	Public Law
PM	Project Manager
POC	Point of Contact
PS	Project Scientist
PSE	Project Systems Engineer
RHU	Radioisotope Heater Unit
RTG	Radioisotope Thermoelectric Generator
RY	Real Year
SAIC	Science Applications International Corporation
SALMON	Stand Alone Mission of Opportunity Notice
SB	Small Business
SC	Student Collaboration
SCaN	Space Communication and Navigation
SDB	Small Disadvantaged Business
SDVOSB	Service Disabled Veteran Owned Small Business
SE	System Engineer(ing)
SEO	Science Enhancement Option
SMD	Science Mission Directorate
SN	Space Network
SOW	Statement of Work
TMC	Technical, Management, and Cost
TRL	Technical Readiness Level

UARC	University Affiliated Research Center
URL	Uniform Resource Locator
U.S.	United States
U.S.C.	United States Code
VOSB	Veteran Owned Small Business
WBS	Work Breakdown Structure
WOSB	Women Owned Small Business

APPENDIX D

PROGRAM LIBRARY

<<Acquisition Homepage URL>>
<<Program Library URL>>

Strategic Documents

NPD 1001.0, *The 2006 NASA Strategic Plan*
The Science Plan for NASA's Science Mission Directorate (2007-2016)
<<Program Name>> Roadmap

Program Specific Documents

<<PROGRAM NAME>> *Safety, Reliability, and Quality Assurance Requirements*
Guidelines and Criteria for the Phase A Concept Study
Launch Services Information Summary
NASA's Mission Operations and Communications Services
The Explanatory Guide to the NASA Science Mission Directorate Educational and Public Outreach Evaluation Factors
The Explanatory Guide to the NASA Science Mission Directorate Educational Merit Evaluation Factors for Student Collaboration Elements
SMD Mission Extension Paradigm

The following NASA Directives may be found in the NASA Online Directives Information System (NODIS) Library (http://nodis.hq.nasa.gov/)

NPD 1001.0, *The 2006 NASA Strategic Plan*
NPD 1360.2A, *Initiation and Development of International Cooperation in Space and Aeronautics Programs*
NPD 2820.1, *NASA Software Policy*
NPD 5101.32, *Procurement*
NPR 5800.1, *Grant and Cooperative Agreement Handbook*
NPD 7100.10D, *Curation of Extraterrestrial Materials*
NPR 7120.5D, *NASA Space Flight Program and Project Management Requirements*
NPR 7120.8, *NASA Research and Technology Program and Project Management Requirements*
NPR 8020.12C, *Planetary Protection Provisions for Robotic Extraterrestrial Missions*
NPD 8020.7F, *Biological Contamination Control for Outbound and Inbound Planetary Spacecraft*
NPR 8580.1, *Implementing the National Environmental Policy Act and Executive Order 12114*
NPD 8610.7D, *NASA Launch Services Risk Mitigation Policy for NASA-Owned or NASA-Sponsored Payloads/Missions*
NPR 8705.4, *Risk Classification for NASA Payloads*

NPR 8715.3, *NASA General Safety Program Requirements*,
NPR 8715.6, *NASA Procedural Requirements for Limiting Orbital Debris*

The following NASA technical standards documents may be found in the public access portion of the NASA Standards and Technical Assistance Resource Tool (START) (http://standards.nasa.gov/)

NASA-HDBK-6022, *NASA Handbook for the Microbiological Examination of Space Hardware (DRAFT)*

The following NASA technical reports may be found on the NASA Technical Reports Server (NTRS) (http://ntrs.nasa.gov/search.jsp)

NASA/CP-2002-211842, *A Draft Test Protocol for Detecting Possible Biohazards in Martian Samples Returned to Earth*

The Federal Acquisition Regulations (FAR) may be accessed at http://www.acquisition.gov/comp/far/. The following parts of the Federal Acquisition Regulations are referenced in this AO.

FAR 15.401, "Contract Pricing Definitions"
FAR 15.406-2, "Certificate of Current Cost or Pricing Data"
FAR 33.101, "Protests Definitions"
FAR 52.219-8, "Utilization of Small Business Concerns"
FAR 52.219-9, "Small Business Subcontracting Plan"
FAR 52.222-26, "Equal Opportunity"
FAR 52.226-2, "Historically Black College or University and Minority Institution Representation"
FAR 52.227-11, "Patent Rights – Ownership by the Contractor"
FAR 52.227-14, "Rights in Data – General"
FAR 52.233-2, "Service of Protest"

The NASA FAR Supplement (NFS) may be accessed at http://www.hq.nasa.gov/office/procurement/regs/nfstoc.htm. The following parts of the NASA FAR Supplement are referenced in this AO.

NFS 1815.208, "Submission, modification, revision, and withdrawal of proposals"
NFS 1852.227-11, "Patent Rights--Retention by the Contractor"
NFS 1852.227-70, "New Technology"
NFS 1852.227-71, "Requests for Waiver of Rights to Inventions"
NFS 1852.233-70, "Protests to NASA"
NFS 1872.308, "Proposals submitted by NASA investigators"
NFS 1872.403-1, "Advisory subcommittee evaluation process"
NFS 1872.705-1, "Appendix A: General instructions and provisions"

The Code of Federal regulations (CFR) may be accessed at http://www.gpoaccess.gov/cfr/. The following parts of the Code of Federal Regulations are referenced in this AO.

14 CFR Part 1216.3, “Procedures for Implementing the National Environmental Policy Act (NEPA)”
15 CFR Parts 730-774, “Export Administration Regulations”
22 CFR Parts120-130, “International Traffic in Arms Regulations”

The United States Code (USC) may be accessed at http://www.gpoaccess.gov/uscode/. The following parts of the United States Code are referenced in this AO.

42 USC 4321 *et seq*., "National Environmental Policy Act of 1969, as amended (NEPA)"

Executive Orders may be accessed at http://www.archives.gov/federal-register/executive-orders/. The following Executive Orders are referenced in this AO.

Executive Order 12114, “Environmental effects abroad of major Federal actions”

APPENDIX E

REQUIREMENTS FOR SUBSEQUENT PHASES

This Appendix provides references to documents that govern subsequent phases of mission development for selected investigations. These documents may contain requirements on selected missions; however they do not place requirements on proposals submitted in response to this AO. Proposed investigations should be implementable within the program and project management environment that these documents describe.

E.1 Phase A Concept Study Reports and Confirmation of Investigation(s) for Phase B

Guidelines and Criteria for the Phase A Concept Study

E.2 Confirmation of Investigation(s) for Phases Subsequent to Phase B

NPR 7120.5D, *NASA Space Flight Program and Project Management Requirements*
<<PROGRAM NAME>> *Safety, Reliability, and Quality Assurance Requirements*

APPENDIX F

COMPLIANCE CHECKLIST

This Appendix contains a checklist with the list of items that NASA will check for compliance before releasing a proposal for evaluation. All other requirements will be checked during evaluation.

Administrative	
1. Proposal received on time	Requirement 1
2. Original signature of authorizing official included	Requirement B-5
3. Electronic cover page and summary (NSPIRES submission) received on time	Requirement 2
4. Proposal includes proposal summary information with content identical to electronic cover page	Requirement B-7 Requirement B-9
5. Correct number of copies each including a CD	Requirement 86
6. Meets page limits	Requirement B-4
7. Meets general guidelines (one volume original easy to disassemble, maximum 55 lines text/page, maximum 15 characters/inch --approximately 12 pt font)	Requirement B-1 Requirement B-2 Requirement B-3
8. Meets general requirements for format and completeness	Requirement 85
9. Required appendices included; no additional appendices	Requirement B-55
10. Budgets are submitted in required formats	Requirement B-49
11. All individual team members are named on cover page indicate commitment through NSPIRES	Requirement 78
Scientific	
12. Addresses solicited science research programs	Requirement 3
13. Requirements traceable from science to instruments to mission	Requirement 4
14. Appropriate data archiving plan	Requirement 5
15. Baseline science mission and threshold science mission defined	Requirement 8
Technical	
16. Complete spaceflight mission (Phases A-F) proposed	Requirement 18
17. Team led by a single PI	Requirement 34
18. Includes commitment for E/PO program	Requirement 50
19. PI-managed Mission Cost within cost cap	Requirement 54
20. Phase A costs within Phase A cost limit	Requirement 56
21. Contributions within contribution limit	Requirement 67
22. Co-investigator costs in budget	Requirement 45
23. Launch date prior to launch deadline	Requirement 80
24. Includes table describing non-U.S. participation	Requirement 73
25. Includes letters of commitment from funding agencies for non-U.S. participating institutions	Requirement 70
26. Includes letters of commitment from all U.S. organizations offering contributions	Requirement 76
27. Includes letters of commitment from all major partners	Requirement 77

APPENDIX G

REQUIREMENTS CROSSWALK

This Appendix contains an approximate crosswalk between proposal requirements in the AO and proposal requirements in Appendix B. Proposal requirements in Appendix B expand upon the proposal requirements in the AO and provide further definition on the structure and content of the proposal. Some AO requirements do not require further definition by an Appendix B requirement. Not all possible crosswalk relations are shown.

<<NOTE TO AO AUTHORS: This crosswalk does not automatically update when requirements are added or deleted from the AO or Appendix B. This crosswalk must be adjusted by hand for each AO.>>

AO Reqmt	AO Section	AO Reqmt Topic	Appendix B Reqmt
1	3	Proposal submission	
2	3	Electronic submission	
3	5.1.1	Science scope	B-15
4	5.1.2	Science traceability	B-16
5	5.1.2	Data plan	B-21, B-22, B-23
6	5.1.3	Measurement traceability	B-17, B-21
7	5.1.3	Instrumentation rational	B-19, B-20, B-26
8	5.1.4	Baseline and threshold mission	B-18, B-26
9	5.1.4	Threshold mission	B-18
10	5.1.5.1	Planetary protection (encounters)	B-63
11	5.1.5.1	Planetary protection (samples)	B-63
12	5.1.5.2	Sample curation	AO OPTION
13	5.1.5.3	Sample allocation	AO OPTION
14	5.1.6	SEO Description	B-25
15	5.1.6	SEO Separable	B-25
16	5.1.6	Extended mission	B-25
17	5.2.1	Complete Missions	B-26, B-27, B-28, B-45
18	5.2.1	Mission architecture	B-26, B-27, B-28, B-29
19	5.2.1	Mission design and operations	B-26, B-27, B-28, B-30, B-31, B-32, B-33, B-34, B-35
20	5.2.1	Flight systems design	B-26, B-27, B-28, B-31, B-32, B-33, B-34

21	5.2.1	Development approach	B-26, B-27, B-28, B-32, B-34, B-36, B-38, B-39, B-40
22	5.2.2	Management approach	B-26, B-27, B-28, B-34, B-41, B-42, B-43, B-44, B-45
23	5.2.3	New technologies	B-28, B-37
24	5.2.4	Environmental review	B-28
25	5.2.5.1	Radioactive material	B-28
26	5.2.6	Space communications and tracking	B-28
27	5.2.6	NASA standard space communications	B-28
28	5.2.6	NASA non-standard space communications	B-28, B-57
29	5.2.7	Critical events	B-28
30	5.2.8	End-of-mission spacecraft disposal	B-28, B-64, B-65
31	5.2.9	Deviations from payload requirements	B-28
32	5.3.1	Principal investigator	B-28, B-42, B-58
33	5.3.2	Project manager	B-28, B-42, B-58
34	5.3.2	PI and PM roles	B-28, B-41, B-42
35	5.3.3	Qualifications of individuals	B-28, B-41, B-42
36	5.3.3	Qualifications of institutions	B-28, B-41, B-42
37	5.3.4	Risk identification	B-28, B-43
38	5.3.4	Risk mitigation	B-28, B-43
39	5.3.4	Descopes	B-28, B-43
40	5.3.5	NASA PI proposals	B-28, B-66
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APPENDIX H

CERTIFICATIONS

Included for reference only. Submission of the signed proposal including Section V of the Proposal Summary Information certifies compliance with these certifications.

Assurance of Compliance with the National Aeronautics and Space Administration Regulations Pursuant to Nondiscrimination in Federally Assisted Programs

The *(Institution or organization on whose behalf this assurance is signed, hereinafter called "Applicant.")*

HEREBY AGREES THAT it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352), Title IX of the Education Amendments of 1972 (20 U.S.C. 1680 *et seq*.), Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and the Age Discrimination Act of 1975 (42 U.S.C. 16101 *et seq*.), and all requirements imposed by or pursuant to the Regulation of the National Aeronautics and Space Administration (14 CFR Part 1250) (hereinafter called "NASA") issued pursuant to these laws, to the end that in accordance with these laws and regulations, no person in the United States shall, on the basis of race, color, national origin, sex, handicapped condition, or age be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Applicant receives Federal financial assistance from NASA; and HEREBY GIVES ASSURANCE THAT it will immediately take any measure necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the Applicant by NASA, this assurance shall obligate the Applicant, or in the case of any transfer of which the Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the Applicant for the period during which it retains ownership or possession of the property. In all other cases, this assurance shall obligate the Applicant for the period during which the Federal financial assistance is extended to it by NASA.

THIS ASSURANCE is given in consideration of and for the purpose of obtaining any and all Federal grants, loans, contract, property, discounts or other Federal financial assistance extended after the date hereof to the Applicant by NASA, including installment payments after such date on account of applications for Federal financial assistance which were approved before such date. The Applicant recognizes and agrees that such Federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the Applicant, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign on behalf of the Applicant.

Certification Regarding Debarment, Suspension, and Other Responsibility Matters Primary Covered Transactions

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 14 CFR Part 1265.

A. The applicant certifies that it and its principals:

1. Are not presently debarred, suspended, proposed for debarment, declare ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

2. Have not within a three-year period preceding this application been convicted or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or Local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

3. Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph A.(b) of this certification;

4. Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or Local) terminated for cause or default; and

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

C. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion -- Lowered Tier Covered Transactions (Subgrants or Subcontracts)

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principles is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department of agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Certification Regarding Lobbying

As required by S 1352 Title 31 of the U.S. Code for persons entering into a grant over $100,000, the applicant certifies that:

1. No Federal appropriated funds have been paid or will be paid by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, in connection with making of any Federal grant, the entering into of any cooperative, and the extension, continuation, renewal, amendment, or modification of any Federal grant;

2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting an officer or employee of any agency, Member of Congress, or an employee of a Member of Congress in connection with this Federal grant, the undersigned shall complete Standard Form -- LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subgrants, contracts under grants, and subcontracts), and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by S1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.